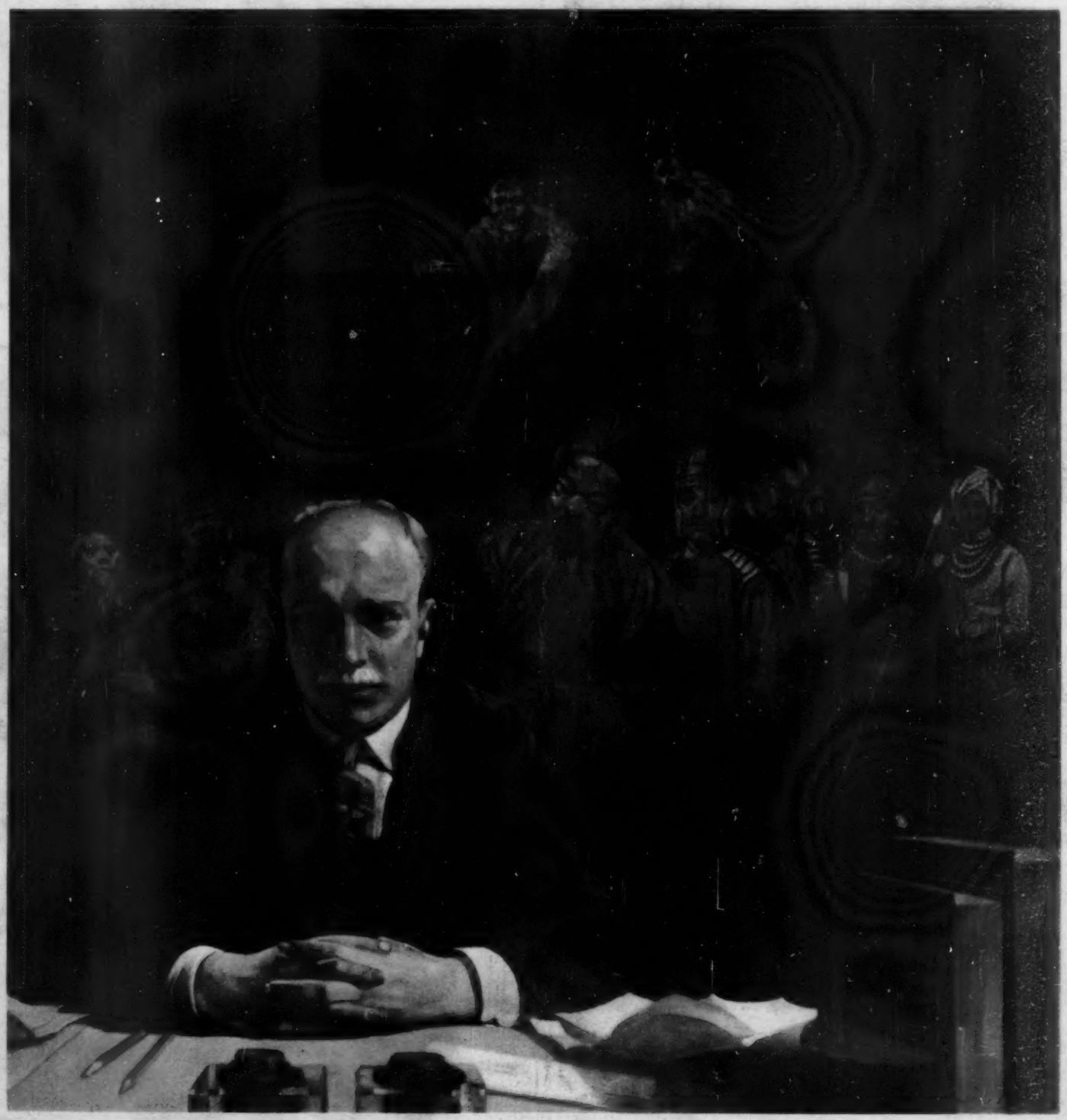
SCIENTIFIC AMERICAN

FEBRUARY 1925



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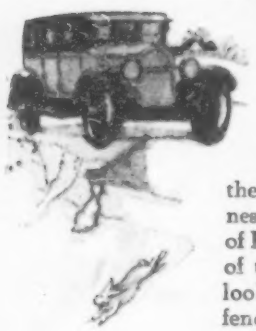

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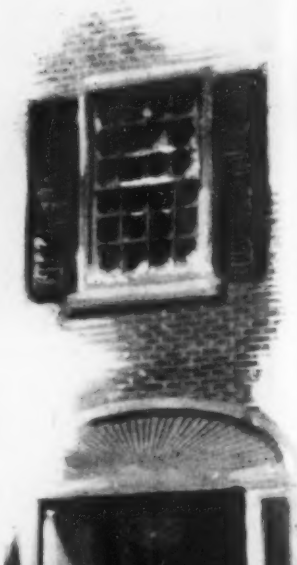

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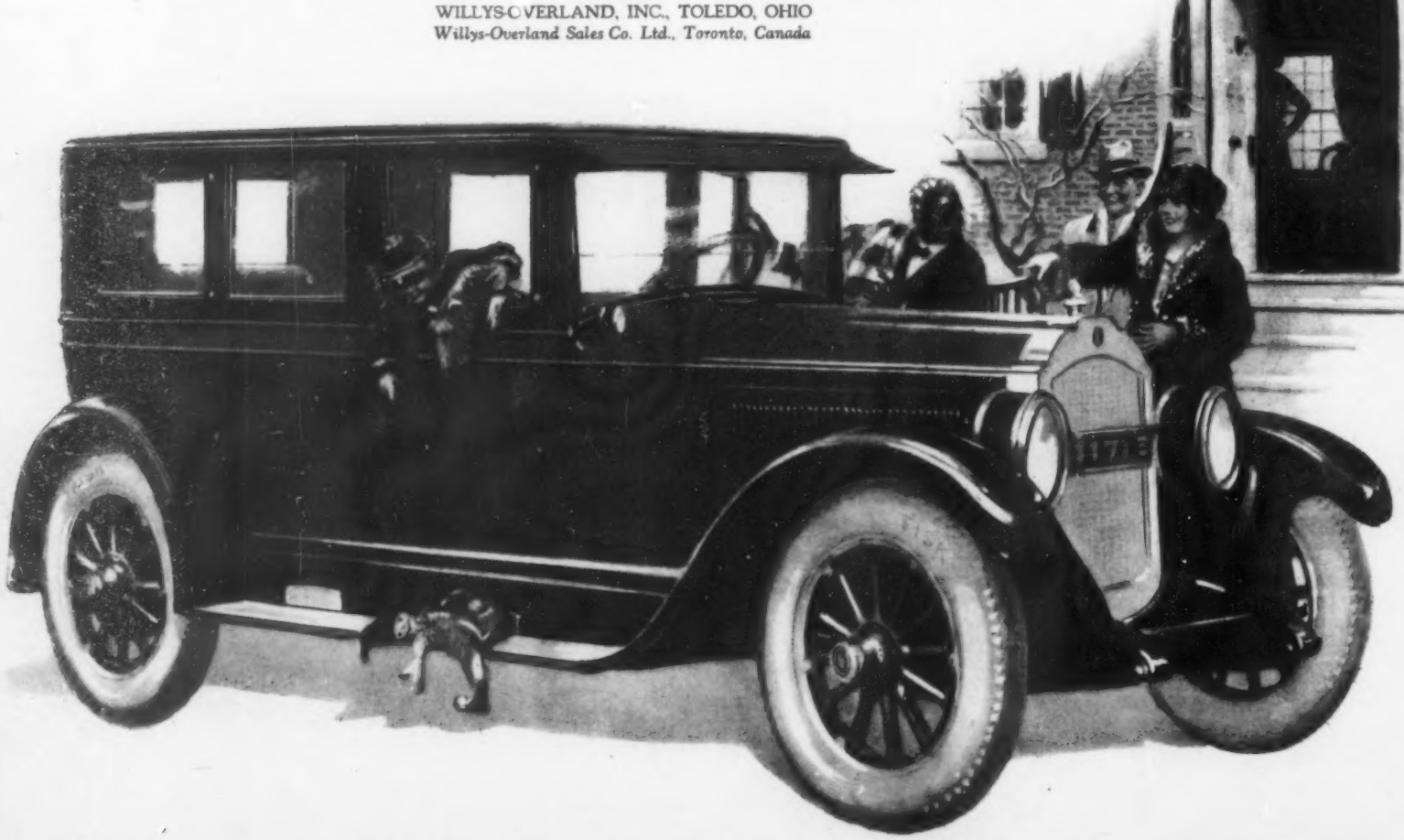

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DREAMS

MR. J. T. DICKERSON has sent us a postcard from a small mining town in Mexico. This town was active once. It is not so any more. In the town Mr. Dickerson found the volumes of the Scientific American for 1868. He spent a day reading them. "What a world of dreams," he writes, "you have buried since then." Yes, many dreams of men who lived in '68 are dead and buried. It is a way with dreams. But some are not. Electric lights, telephones, motor cars, radio! These have come alive and stayed. And that, too, is a way dreams have.

GOLD

THE investigation of the supposed transmutation of mercury into gold is in full swing. Mercury vapor lamps, especially made for us by the best experts in America, are running in Professor Sheldon's laboratory at New York University. The mercury in them has been purified carefully. We feel sure that it contains no accidental trace of gold.

When the test runs are completed the lamps will be taken down and the mercury will be analyzed. If it does contain gold we shall feel sure that Professor Miethe was right in his claim that he succeeded in making gold in this way in his laboratory near Berlin. The results will be announced as soon as they are certain. Meanwhile, we print on page 81 of this issue some diagrams of atomic structure, including one of the atoms of mercury, the atom which we are trying to transmute into an atom of gold.

FACTS

AS these lines are written the first edition of our new list of radio sets, published in the January issue, has been before the public only a few days. We are pleased that a number of readers have congratulated us on it. Several radio set manufacturers have done likewise. A few have protested. We are investigating their complaints. If we have done any injustice we will correct it. But we will continue to tell exactly what we believe to be the facts. Radio needs to be de-bunked. Excessive claims for the performance of receivers are not good for anybody—least of all for the radio industry.

SPIRITS

MANY persons have called to our attention the fact that the little snapshot of Houdini which we printed on page 385 of the December issue contains an evidence of a sort of "spirit photography." Among the spots of light and dark which constitute the image of the trees and foliage above and behind Houdini it is possible to discern the outline of two faces, formed as in the familiar puzzle pictures.

Needless to say, this appearance was not intentional. The photographer, the engraver, ourselves and the "spirits" are believed to be equally guiltless. We blame it on plain luck.

In This Issue

More About the Flettner Rotor Ship

New facts have been received from Germany about the famous sail-less ship, the ship with the two tall stovepipes instead of ordinary sails. Mr. Herzog tells on page 82 the details of construction, operation and theory of the invention.

Do Vegetables Grow on Mars?

Photographs made in California and Arizona indicate that Mars has a good deal of air—at least an atmosphere of some kind. If this atmosphere contains oxygen there probably is life on Mars too. See page 97.

What Race Produces the Best Men?

Are the whites better than other races? Is the "white man's burden" a duty or a piece of bunk? If you have a dark complexion are you therefore inferior? Read the article on race and our immigration policy on page 77.

The Steam Horse Grows Another Lung

Most steam locomotives have two cylinders. The newest kind has three cylinders. It pulls more load. It starts more easily. Read the article on page 88.

We Catch the Cross-word Puzzle Craze

They say that cross-word puzzles are educational. Undoubtedly they are interesting. All America agrees about this. We are joining the procession. Our first cross-word puzzle effort will be found on pages 130 and 131 of this issue.

MORE THAN ONE HUNDRED PICTURES

Complete table of contents will be found on page 144

For Next Month

Is the Auto a Dangerous Weapon?

More people are killed daily by automobiles than are shot with guns. These accidents must be stopped. The question is how. Mr. H. W. Slauson represented us at Mr. Hoover's traffic conference. He has some ideas about traffic. He will tell them in our March issue.

What Minute Will You Die?

There is an idea that more people die between midnight and one in the morning than at any other time. Is this idea true? The Scientific American has investigated over 26,000 deaths. The results will be printed in the March issue—out February 20.

Can Man Do Without Fire?

Yes, says Mr. Calvert Townley. Fire was a good servant to savages. It is time it was retired. We can do industrial heating now with electricity. Factory owners or executives must not miss his article next month.

Other articles on Airships, Radio, The Ferocious Hunting Spider, New Inventions, Progress in Astronomy, A New Cross-word Puzzle.

MORE THAN ONE HUNDRED PICTURES

¶ You will want these articles—also the puzzle. Remember, we send you a three-months' subscription for a dollar.

The time to send us that dollar is now.

Don't put it off!

STEEL

AS our readers will note by the Editorial Page of this issue, Mr. Walker has recovered and is back on the job. Mr. Walker is glad, the rest of our staff are glad, we are sure that you will be glad—so that makes it unanimous.

There are to be at least two more chapters of the Story of Steel, which ran last year in our columns from Mr. Walker's pen. They will appear soon. Mr. Walker will then begin his promised series on oil.

NUMBERS

THE human mind suffers from an incurable desire to be fooled. If the foolishness can be mysterious so much the better. Which is apropos of Miss McMein who draws pretty girls—incredibly pretty girls—for incredibly popular magazines and at incredible prices.

Miss McMein has a piece in the Cosmopolitan about numbers and names. It seems that Neysa is not her name at all—strange, but we had already suspected this—and that it belonged, in reality, to a horse. Miss McMein was christened Marjorie. But there is a new "science" of numerology. This science does things with numbers to the letters of your name. If the numbers and the name fit, all right. But if they don't fit there is only one thing to do. You must run forthwith and change your name.

Marjorie turned out to be wrong. Something had to be done. About that time Miss McMein met the horse. The rest was inevitable. Nowadays, with the new name—which fits the numbers perfectly—Miss McMein never suffers from sore throat, which used to bother her very much indeed.

Miss McMein draws very well. We once knew a horse named Nebuchadnezzar. It's a good thing he wasn't handy on the fateful day. The human mind is fearfully and wonderfully made—sometimes.

THERMOMETERS

ON the fifth of November, 1667, the Royal Society met in London. On that particular fifth of November the chief matter for discussion was a plan to procure a good thermometer for the use of the Queen of England. That was how scarce thermometers were in 1667.

GONE

THE Scientific American has suffered a great loss. Mr. Cyrus L. Topliff, who came to work with us sixty-three years ago has laid down his ledgers for the last time. The man of longest service among us has said goodbye to life. Many of our friends who have visited us in our own home will remember Mr. Topliff well. For more than fifty years our contributors have been seeing Mr. Topliff's signature on their checks. Few men have worked so long and so happily with one institution as Mr. Topliff did with us. None have left a greater sense of loss behind them when it came time to go.

EIGHTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, FEBRUARY, 1925

Which Races Are Best?

The First Article of a Series on Immigration

By Albert A. Hopkins
Associate Editor

IT may be true that all men are created free and equal but the immigration law of the United States does not believe it. In choosing the new citizens whom we will admit to the benefits of our institutions and to a share in our natural resources we proceed according to the idea that some races of men are better than others.

The yellow race we make an effort to exclude altogether. Even between the sub-groups of the whites we attempt, as our quota provisions make evident, to discourage the entry of the dark-whites of southern Europe in favor of the blonde-whites or "Nordics" of the north. The whole basis of our present immigration policy, as well as of all policies recently proposed, is discrimination between prospective immigrants on the ground of race.

When one sets out, then, to assemble and assay the scientific facts which bear upon our immigration policy the first facts to be collected ought to be, it is evident, the facts about the races of mankind. What races really are the best, either for future citizenship or for other things? Are the Nordics really better than the dark-whites or are they worse? Which races will blend successfully with our present population and which will not? What are the essential differences between the races? How did the different races originate and what are the relations, biological and otherwise, between them? It is questions like these which the modern statesman, intent to solve our immigration difficulties, is asking the scientists to answer.

There Is No Pure-bred Race

Unfortunately but few of these answers are ready. Among all the domesticated animals man is the one, it seems, about which we know the least. Yet there are three things about present-day humanity which it does seem possible to say. None of them is especially flattering to our racial pride.

The first is that there is no such thing in the modern world as a pure-bred race. The "pure Nordic" idea is a myth.

The second is that not one scrap of real evidence exists to prove that any one race is potentially abler or more honest or more intelligent than any other race. The "white man's burden" may be laid down any time with a clear conscience and with no fear that we are deserting our duty to the world.

The third is that racial mixture—even to what we would shrink from as extremes—seems much more likely to be beneficial to civilization than the reverse.

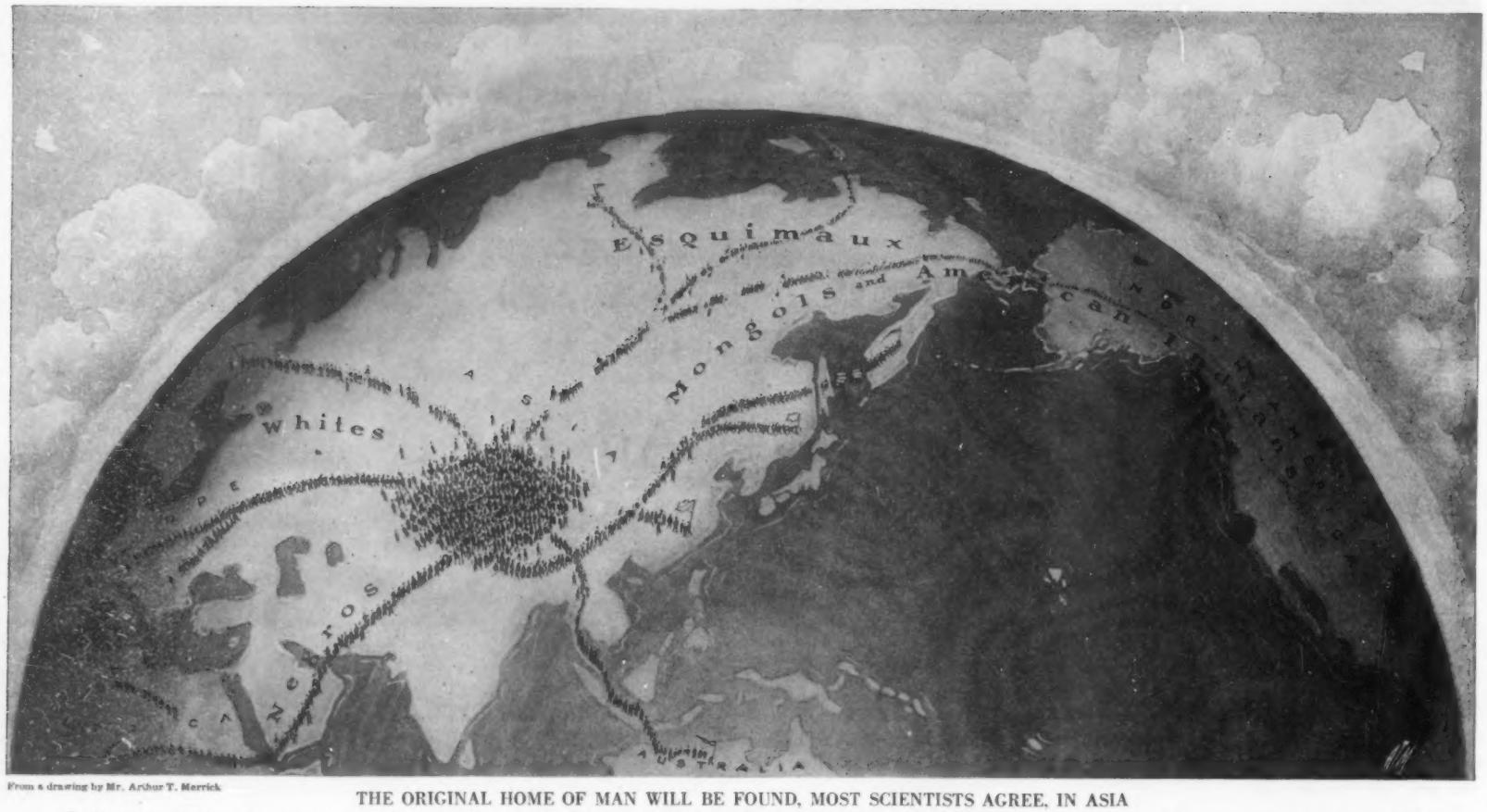
Within the limits of a single brief article it is impossible to marshal all the evidence which supports these three conclusions or to do full justice to the arguments which have been urged, more or less cogently, for or against them. It may be said, however, that the facts on which these three conclusions rest have been discovered, in the main, during that remarkable advance of knowledge about ancient, prehistoric humanity which has resulted from the excavations and museum studies of the last four decades.

The foundations of our modern immigration difficulties were laid by Central Asian savages more

From a mural by Charles R. Knight. Courtesy of The American Museum of Natural History

EVEN IN THE PREHISTORIC DAYS THE TRIBES AND FAMILY GROUPS WERE OF MIXED RACE

Many small groups of men and women like those depicted by Mr. Knight in this drawing seeped out of Asia in the New Stone, or Neolithic Age and formed the first settled population of Europe. Previous men had been merely hunters.



From a drawing by Mr. Arthur T. Merrick

THE ORIGINAL HOME OF MAN WILL BE FOUND, MOST SCIENTISTS AGREE, IN ASIA

Each great migration that gave rise to what we call a "race" already contained people of many different bloods. More mixture occurred as the migrations met and fused

than a hundred thousand years ago. It is not impossible that the solution of these difficulties will be found in the careful study of the lives and bodies and relations of these same long-forgotten men.

The older geographers were accustomed to divide mankind into five races: the white, the black, the yellow, the brown and the red. It has been apparent for years that this classification is unsatisfactory; indeed, that it is impossible, although it persists to a considerable extent in the public mind. Its impossibility lies in the fact that the differences between these five so-called races are not sharp. There are yellow-brown races and black-white ones. What are we to say of the Turks and Lapps, who are white yet have distinct Chinese-like traits? Are the African pygmies negroes or a separate race? What are the Esquimaux?

The Brief Moment of History

The fact is that no exact classification of races is possible. Mankind forms one great family. Inside this family it is possible to distinguish ten or fifteen groups which differ more or less sharply from each other: the Negro, the Chinese, the American Indian, the Jew, the blonde-white or Nordic, the dark-white, the "blackfellow" of Australia, the brown islanders of the Pacific, the Esquimaux, and so on. There are many blends between these groups. The separations between them are not sharp; indeed, it is only the extremes which are clearly distinct at all. That is the present-day racial picture of the earth.

It has been the picture during all of that brief moment of the earth story that we call historic time. But this historic time covers less than ten thousand years. Man has been on earth, essentially in his present bodily form, for at least a hundred thousand years, possibly for five or six times as long as this. The origins of races, the roots of our present world politics, go back into this dim and distant prehistoric period when the great drama of the peopling of the earth was just beginning to unfold.

The first act of this drama was played, we believe, among the mountains and highland plains of Central Asia. It was here that the prehuman ape-men learned to walk erect, acquired the grasping thumb and finger of the human hand, began the development of that marvelous collection of little grey cells which forms the brain and which sets man apart, utterly and forever, from all the other animals. By some one hundred thousand or two hundred thousand years ago all this was accomplished. Somewhere in Asia creatures who were clearly men were alive and active on the earth.

We have not yet found the bones of these first men. The recent American expeditions to Asia have had this for their object. Perhaps they will succeed; perhaps not. It was a long time ago, the first men were probably never very plentiful, only some happy accident will give us their actual remains.

This does not matter very much. We already know a great deal about the ape-man cousins of these first men. The main lines of human evolution may be considered known: Asia as the place of human origin is highly probable; the fact of man's development out of lower ape-like creatures is unquestioned by any modern scientist of note, Mr. William Jennings Bryan to the contrary notwithstanding.

Climate Rules Complexion

Exactly how these first men diverged into the different races of modern times is by no means so certain. We know that men, like other animals, are much modified by the conditions under which they live. In the sunlit tropics the human skin grows darker and the hair apparently grows short and kinky. In the dimmer days and longer nights of the north the skin grows white and the hair long and blonde. Nobody knows why this happens but it does happen. Many similar modifications are known. These facts provide a clue, we believe, to how the races may have originated.

In the Asian homeland there has never been much food to spare. Within historic times there have rolled out of Asia over the rest of the world the successive human waves of the Hittites, the Persians, the Goths, the Visigoths, the Huns. Eastward, in the same period, swept the tide of Mongols. Famine drove them all. Always Asia is the mother of peoples. Always the mother drives her peoples out, from time to time, to conquer other lands where food is easier to come by than it is at home.

Now this short part of the drama that history has seen is probably little different in essentials from the long preceding part about which history tells us nothing. From the very beginning there have probably been groups and tribes of men who emigrated out of Asia. In between the greater waves and in that probable less pressing period before the greater waves began, a thin trickle of humanity has seeped slowly out of the mother country, adding its leaven to the growing population of the world.

Black Men Were the First

Here is our mechanism for the creation of the races. In very ancient times, for example, a wave of peoples probably swept out of Asia to the south and west. Travel was slow in those days and to say that they "swept" out is possibly less accurate than to say that they crept out. For millenniums, perhaps, they advanced slowly through the tropical lands along the southern coast of Asia, the eastern coast of Africa. These tropical lands left their marks of black skin and kinky hair. The result is the negro race.

Millenniums later another wave of peoples rolled out toward the east. These people had, or acquired, a yellow skin, coarse black hair, the slant eyes of the Chinese. Hence the original yellow race. An offshoot from this eastward, yellow-skinned migration resulted, probably, in the main strain of the American Indian.

Still later, but yet far earlier than any scrap of recorded history, Asia began to disgorge the successive waves of peoples whom we include in our own race of whites.

Races have originated, then, by the slow alteration, under force of climate and other circumstances, of successive migration waves out of Asia. Possibly the stock left behind in Asia changed between successive migrations. In any event, each wave of migrants encountered different conditions when it got outside. All these changes have worked together to make the diversity that exists today. Every few centuries the pot of Asia boils over. Each froth that runs out is a slightly different human froth.

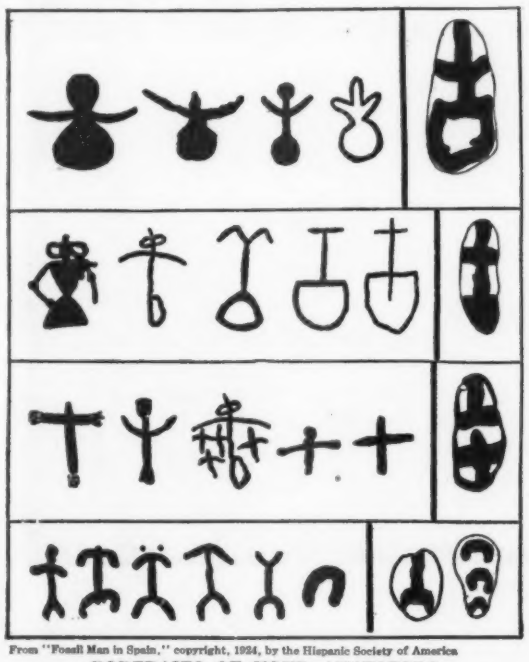
Since the very first millenniums of this process the peoples who have erupted out of Asia have not found an empty world which they could occupy at will. Instead they were confronted with a world already too well filled. Hence the appeal to the sword, followed, in time, by some kind of racial fusion between the conquerors and the conquered. For more than a hundred centuries, then, the world has been a laboratory for mixing and blending races. In historic times we have full records of many examples. In prehistoric times we have evidence, although less unmistakable evidence, that the same thing was going on.

Skulls Provide the Clue

One result of this is the conclusion that racial mixture is no new thing in the world. America is not the first "melting pot." Indeed, there is ample evidence that no race anywhere in the world has kept itself unmixed with strains of other races who left Asia sooner or later than it did.

A short time ago Professor Roland B. Dixon of Harvard University tested some of these ideas by a strictly scientific method. He collected all the human skulls that he could find, both modern and prehistoric. He measured the relative dimensions of these, what are called the indices of height, width, length and so on, commonly used by anthropologists as one of the criteria of race. In addition he collected all the similar measurements which had been made by other anthropologists. He set down all this data and compared it.

One of his most remarkable conclusions was that every race, no matter in what part of the world, showed evidences of mixture with other races. Many of the American Indian skulls showed negro-like characteristics. Some of the negro skulls were more or less like the Chinese. Many white skulls showed traces of the admixture of Chinese or Negro or American Indian blood.



From "Fossil Man in Spain," copyright, 1924, by the Hispanic Society of America

PORTRAITS OF YOUR ANCESTORS

At the left are shown prehistoric human symbols from Spanish caves. At the right are painted pebbles with similar designs

The most probable explanation of this, an explanation which is supported by a vast array of other evidence, is that during the long period of man's presence and migrations on earth all of the races have been more or less mixed with each other.

Consider Professor Dixon's analysis of the peopling of America with the races which fused to form the American Indians. The first to arrive, he believes, were successive waves of a negroid people and a people whom he calls the "Caspian" race. Both were long-headed. The Caspians were probably one of the ingredients, by the way, of the much later Nordics, developed around the shores of the Baltic Sea in North Europe. For even the famous Nordics are a racial blend.

We Need an Immigration Policy

Our present immigration law is admittedly a makeshift. A better law is urgently needed. To be really better it must be based on facts—not prejudice.

In this article Mr. Hopkins has told you some of the basic scientific facts about the baseless bugaboos of race inferiority and race mixture.

In later articles other experts will discuss the economic side of immigration, the menace of cheap labor—if it be a menace—the proper administrative machinery for the control of immigration, all the fundamentals of this pressing American problem.

If you have ideas of your own about the proper American policy, or if there are certain facts which you especially want to know, write and tell us so.

Following these two early migrations into America came a wave of round-headed people of much the same type as those now found in the mountain regions of Europe and sometimes called the Alpine type. Finally there came a seepage of mongol-like people more or less closely related to the present Asiatics. Even other racial elements seem to have filtered into America and to have left their traces in the nature of the Indians.

These Indians, the men whom Columbus found here when he came, were merely a blend of all these earlier types, more or less modified, of course, by the climate and the natural conditions under which they lived. The red skin was merely a blend, we believe, of yellow, black and white, doubtless modified in some fashion by the characteristic American complex of light and air and sun.

It has even been suggested, with no inconsiderable reason, that American conditions will redden any skin in time and that the whites who live on this continent for ten thousand years, if any do live for so long, will end as ruddy as did the previous population which we have displaced during the past four hundred years.

However this may be, the white race is already as blended as any other. In our ancestry, as in that of the American Indian, we can trace the elements of early negroid races, of the Australian savage, of the same Alpines who helped to settle America, of mongols, of half a dozen others. Among the ancestors of every American business man one could find, it is safe to say, every important racial element of prehistoric times; every type of human animal in the world, from the Chinese philosopher to the savage chieftain of a caveman tribe.

This is the argument for our first conclusion, the conclusion that there is no such thing as a pure-bred race—not even a pure-bred individual—in the modern world. All of our so-called races are already blends. Why should we be afraid of further blending?

From this argument, too, it is easy to see that no great case can be made for any superiority of certain races over other races. The great peoples of the past have not been of pure race. All of them have been, like us, the products of slow but effective racial mixture.

At the last meeting of the American Philosophical Society in Philadelphia two scientists argued pro and con the problem of whether or not the white race is superior to the negro. The argument was inconclusive. It had to be. It is almost certain that both of the gentlemen in question, as well as the assemblage of distinguished scientists who listened, had both white and negroid elements in their ancestry, in their blood, in the very bones of their heads like those which Professor Dixon measured.

To talk of menaces in racial mixture is equally absurd. If racial mixture could have ruined mankind that ruin would have been completed many millenniums before any scribe set down one word of history. Indeed, a degree of racial mixture seems actually to be stimulating to human intelligence and human enterprise.

Shall We Let Down the Bars?

It was a mixed race that baked bricks in the plains of the Tigris and Euphrates and built the walls of Babylon. It was another mixed race in the Valley of the Nile that dug the stones which went to make the Pyramids. It was a third mixed race which forged the power of Rome, another which lit that Grecian torch of learning that still burns in the minds of men. If it be these things that mixed races do let us have more, not less, of racial mixture in our world!

Does it follow, then, that we should let down the bars of our immigration law, that we should admit anyone, urging the most diverse peoples to come and mix with us, to help us eat up what we have?

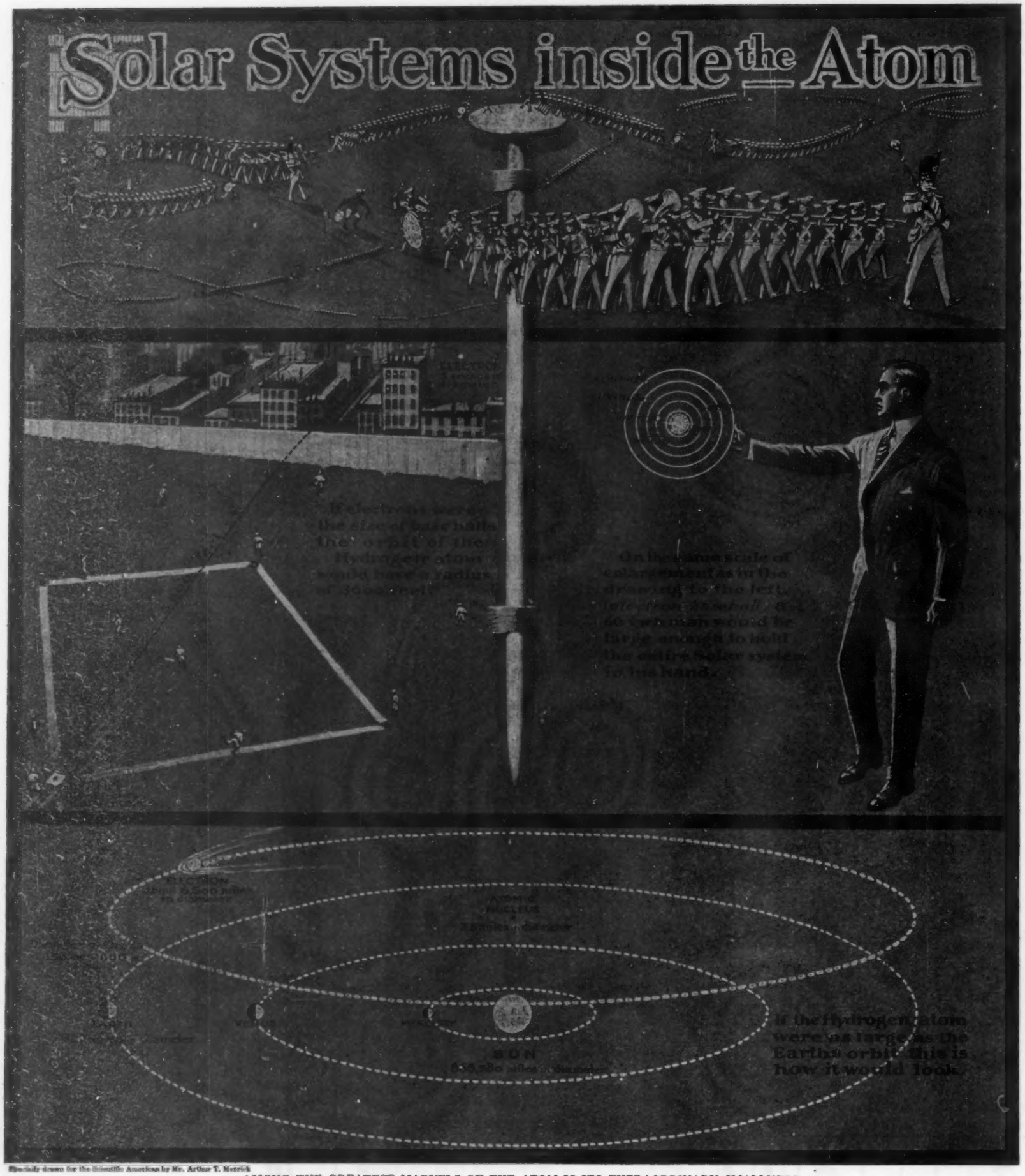
By no means. This is an article about *race* and immigration. There are other factors of the problem; economic factors, religious factors, educational factors. Some of these the Scientific American will discuss in later articles of this series. It may be that these other factors are more important than racial ones.

But it is important to know why we decide as we do. And it is worth while to see, as a first preliminary to the scientific study of the problem, that racial differences are much less sharp and rigid than we have been accustomed to imagine. The most diverse of races are but our cousins who left the ancestral Asian roof-tree a little earlier or a little differently than we did ourselves.

From "Fossil Man in Spain," copyright, 1924, by the Hispanic Society of America

A PREHISTORIC BEE MAN

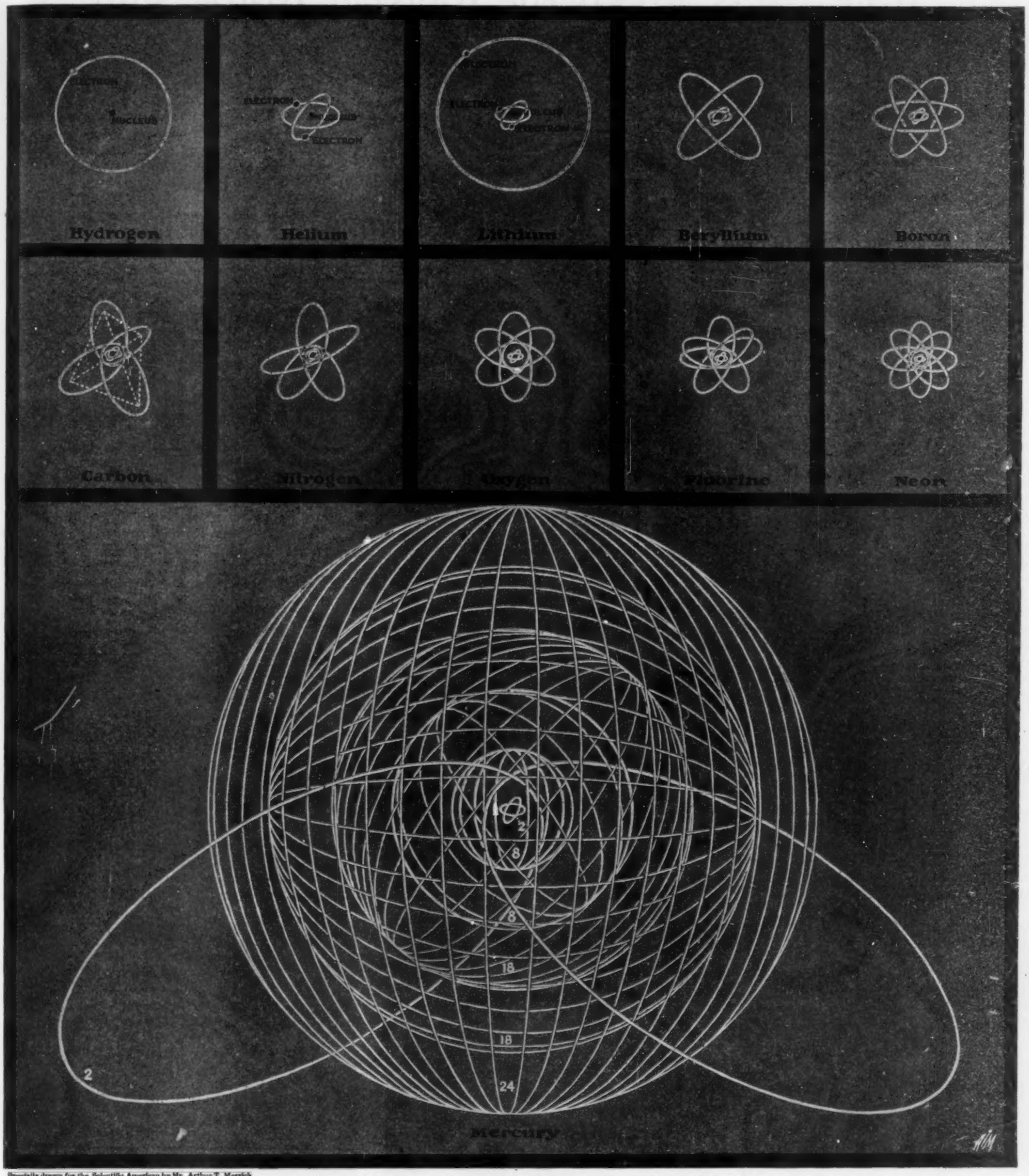
This ancient rock painting from a cave in Spain apparently represents a man gathering honey. The flying creatures are presumably bees



Specially drawn for the Scientific American by Mr. Arthur T. Merrick

AMONG THE GREATEST MARVELS OF THE ATOM IS ITS EXTRAORDINARY SMALLNESS

The simplest kind of atom is the atom of hydrogen gas. This atom contains only two particles; a tiny nucleus and one electron, which revolves around the nucleus much as our earth revolves around the sun. Both the particles themselves and the orbit of the electron are so small that if enough hydrogen atoms to make one layer on the surface of a pinhead were enlarged to the size of men and formed fifty abreast into a parade, it would take over 10,000 years for all of them to pass by. Yet, small as it is, most of the inside of the atom is empty space, as you can see by the comparison of the electron with a baseball, as Mr. Merrick has illustrated it above.



Specially drawn for the Scientific American by Mr. Arthur T. Merrick

THE TEN SIMPLEST ATOMS AND ONE OTHER THAT IS NOT SO SIMPLE

The atoms of other chemical elements differ from the hydrogen atom in having larger numbers of electrons revolving around the atomic nucleus. The diagrams at the top of this page illustrate the numbers of orbits in the ten simplest atoms. Helium has two electron planets, Lithium has three, Beryllium has four, and so on, up to Neon which has ten. The ten diagrams are drawn approximately to scale. At the bottom is a diagram (on a much larger scale) showing the number of electron orbits in an atom of mercury. It is by knocking one of these electrons out of the mercury atom that we hope to make gold, as described in the Scientific American for December, 1924.

More Facts About the Flettner Rotor Ship

The Constructional, Operating and Theoretical Data for This Remarkable and Novel Sailing Ship, Some Illustrations of Which Were Presented in Our Last Issue

By H. O. Herzog
Consulting Engineer, Berlin, Germany

THE veil of secrecy which has surrounded the details of the new rotor sailing ship invented by Herr Anton Flettner and so much discussed in the newspapers and technical periodicals of the entire world was lifted recently by the inventor himself in an address before the German Society of Naval Architects. In this address Herr Flettner summarized the experimental work which led up to his invention, described in detail the operation of his ship, illustrating the whole with motion pictures, and laid his ideas in full before the engineering world.

Herr Flettner is an engineer who has already made a name for himself by the so-called Flettner rudder, now used extensively in Germany and abroad. In the present investigation, however, his primary object was to increase the efficiency of the sailing ship. He was of the opinion, in the beginning, that the application of modern aerodynamics could not fail to produce improvements in the sailing vessel. Here, however, he encountered disappointment.

Sails made of thin metal proved superior in the matter of effective momentum but were too top-heavy and too difficult to manage to be of practical use. After testing all the possibilities in this direction Herr Flettner embarked, ultimately, on an entirely new line of research. His starting point was the so-called Magnus effect, named after the famous Berlin scientist Magnus who proposed as far back as 1853 a theory, now rejected by many, in explanation of the well-known side deflection of an artillery projectile rotating around its axis.

Effects Due to Air Friction

If an object, for example, a cylinder is placed vertically in a current of air it will be encircled by the latter equally on both sides. If this cylinder is given a rotary motion it is discovered that the air current deviates strongly to the one side on which the circumference of the cylinder is moving with the current. This is explained by the increased air friction on the one side and diminished air friction on the other side due to the rotation of the cylinder. Another way of stating this theory is to say that

Dr. Alfred Gradenwitz

HERR ANTON FLETTNER

Well-known German marine engineer and inventor of the new method of ship propulsion by wind

because of friction a film of air rotates with the cylinder. On the side where the rotation of the cylinder is counterwise to the current of air this film of air produces congestion and consequent pressure. On the other side it produces suction.

A force thus results acting on the cylinder at right angles to the direction of the current of air. This fact was well known but was considered of no practical value. Mr. Flettner claims the merit of having discovered that the force thus produced can assume under certain circumstances, a considerable magnitude, by far surpassing the propelling power of ordinary wind pressure on the same cylinder or other object when the object is at rest.

These tests have revealed the fact that the force of suction on the one side of the cylinder when it is rotating is much larger than the force of pressure on the other side. The algebraic sum of these two —which sum is equal, of course, to the difference in air pressure against the cylinder on its two sides—is the force which serves to propel the ship equipped with Herr Flettner's rotating towers or "rotors."

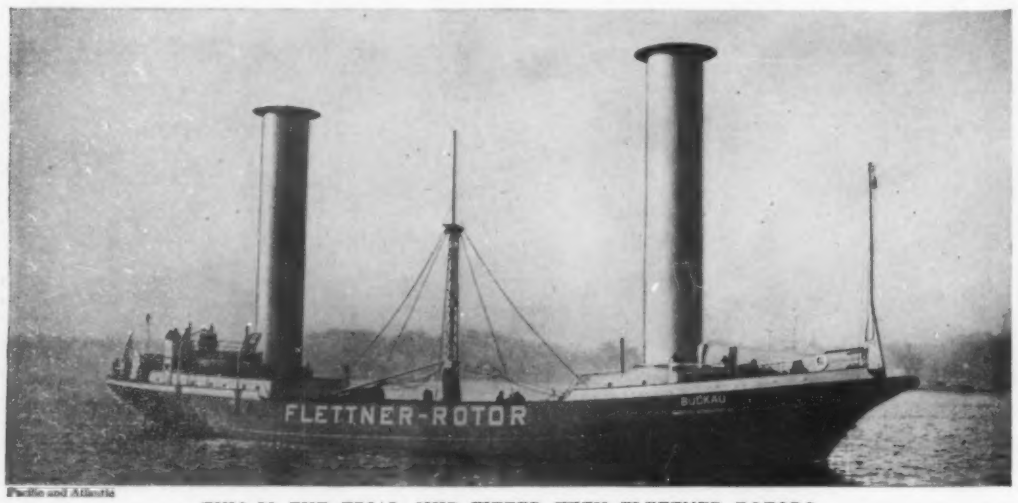
The magnitude of this force varies with the ratio between the circumferential speed of the rotating cylinder and the velocity of the wind. When these speeds are equal this ratio is 1 and the propulsive force created by the Magnus effect is equal to the lateral wind pressure against the cylinder. As the speed of the cylinder increases, the propulsive force increases also until it reaches a maximum when the ratio of the two speeds is approximately 3.5 to 1. At this maximum, the propulsive force caused by the Magnus effect is approximately ten times as great, Herr Flettner reports, as is the direct pressure of a wind of the same velocity against the stationary cylinder.

For example, in a wind having a velocity of thirty feet a second (about twenty miles an hour) and with a cylinder having a circumferential speed 3.5 times as great, or 105 feet a second, the propulsive force will be approximately ten times greater than the force against a sail having the same cross-section as the cylinder. It should be emphasized that the cylinder speed is the *circumferential* speed, not the speed of rotation.

Inventor Could Not Obtain Support

This astounding increase of wind pressure due to the rotation of the cylinders does seem to justify the enthusiasm acclaiming the Flettner invention as the discovery of a new power. So unexpected was the discovery and so fantastic did its practical application seem, that the inventor encountered a good deal of scepticism when trying to enlist help to carry on his work and to put it into practice. This was not mentioned, of course, in Herr Flettner's paper but it is an open secret that he found in the whole of Germany hardly anyone whom he could convince of the feasibility of his invention, much less someone to finance it. It was only with the help of Dutch capital that the inventor could complete his tests and proceed to practical trials.

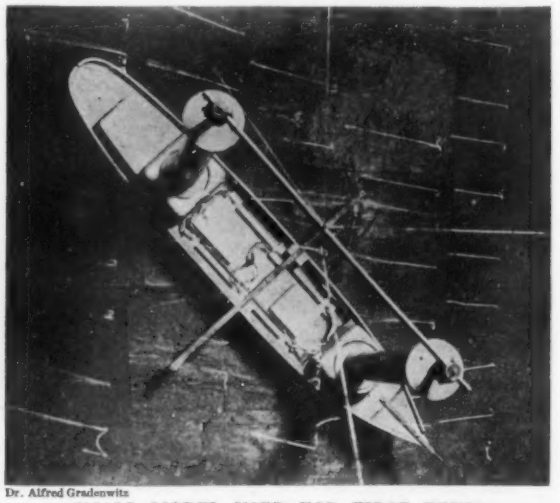
It was for these trials that the 600-ton brig *Buckau* was bought, her rigging removed and re-



Pacific and Atlantic

THIS IS THE TRIAL SHIP FITTED WITH FLETTNER ROTORS

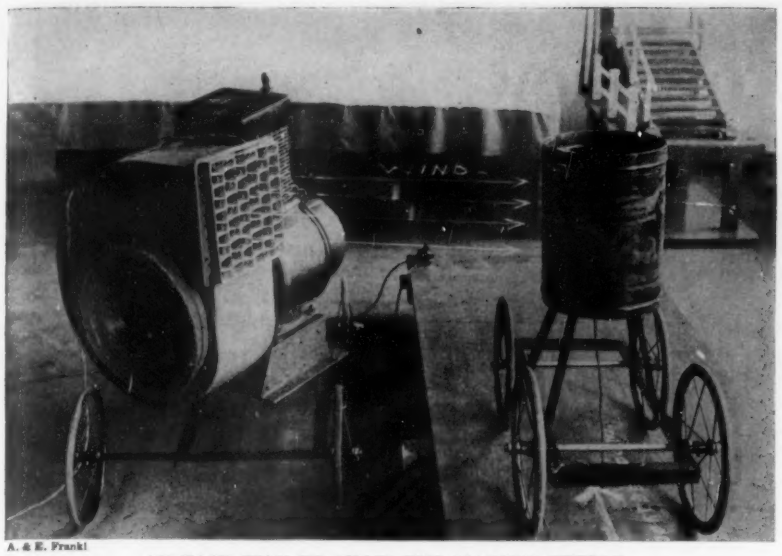
The brig Buckau of 600 tons carries two revolving towers of sheet-steel, each 52 feet high and 10 feet in diameter. The rims at the tops of the towers are important



Dr. Alfred Gradenwitz

SMALL MODEL USED FOR FIRST TESTS

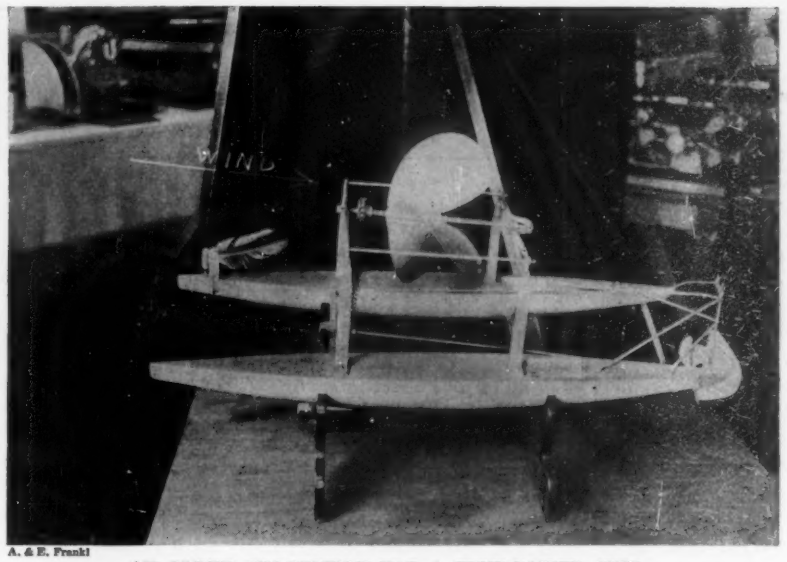
This small model, only a few inches long, had pasteboard towers rotated by clockwork. Note the threads showing wind direction



A. & E. Frankl

AN EASY WAY TO SHOW THE MAGNUS EFFECT

The metal cylinder mounted on the small carriage is rotated by an electric motor. The carriage then moves across the wind



A. & E. Frankl

AN OLDER SUGGESTION FOR A WIND-POWER SHIP

This model, built by J. Smit in Holland in 1890, was intended to operate by a windmill which was connected, in turn, to the screw

placed by the Flettner equipment. This consists, first of all, of two round, tapering standards, mounted in the place of the masts. These act as supports for the rotors. The rotors are vertical cylinders, 52 feet high and 10 feet in diameter. These cylinders have a sliding bearing at the base and another one at about two-thirds of the cylinder height above the deck. The cylinders are made of steel sheets, 4/100 inch thick, strengthened internally by steel webs. Inside the cylinders are two inspection platforms, over the bearings. These are accessible through manholes. The inventor further pointed to the possibility of increasing the propelling power of the vessel by making the cylinders of corrugated sheets.

The cylinders carry at their tops a rim projecting about fourteen inches. This rim has a special function. It preserves the pressure and suction zones extending lengthwise on the respective sides of the cylinder and prevents these zones being penetrated by outside air from above.

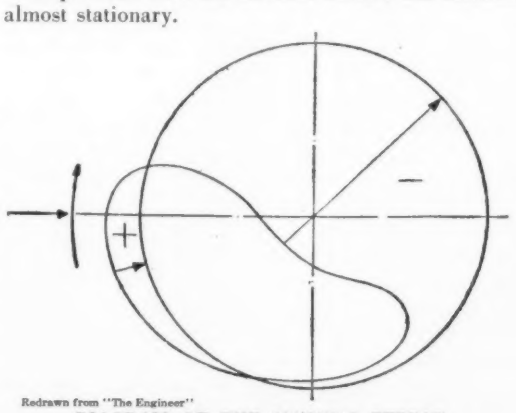
The projected area of this whole super-structure is about 940 square feet. The propelling power which the two cylinders produce under wind pressure if rotated at a ratio of $\frac{u}{v} = 3{,}5$ (in which "u" is the circumferential speed of the cylinders and "v" is the velocity of the wind) equals that of two sails with a combined area about ten times as large, that is of 9,400 square feet. The inventor stated that on the trial runs with the *Buckau* a speed of nine miles an hour has been achieved in a wind of medium force. Exact data were not given. It was stated merely that the cylinders rotated at a speed of 100 revolutions per minute. This corresponds to a circumferential speed of 53 feet per second and for the above relation of $\frac{u}{v} = 3{,}5$ the velocity of the wind would be only 15 feet per second, which makes the stated ship speed look highly improbable. However, more data will doubtless be available soon.

Revolving Power from Diesel Engine

Power for the rotors is provided by two direct-current, shunt-wound electric motors, each of 11 kilowatt rating. Both motors are reversible and operate at 220 volts and 750 revolutions per minute. Power is supplied by a two-cylinder Diesel engine rated at 45 horsepower. This engine may be directly connected, it is stated, to a screw, when it serves to propel the ship in the usual fashion, although at a slow speed. Storage batteries may be used to take the current from the generating system when not needed, and supply it to the rotor motors later on when it is needed.

A special study has been made, the inventor said, of the important problem of stability under heavy wind pressure. The weight of the whole super-structure is now 20 tons, the cylinders alone weighing three tons each. The complete former rigging of the vessel weighed 35 tons. Curves were shown comparing the wind pressure on a close-reefed rig and on Flettner's rotor stacks, both when at rest and in motion. According to these curves the wind pressure on the two stacks combined when at rest is only about half that on the corresponding close-reefed sailing rig. Herr Flettner explains that circular stacks of such large diameter produce less wind pressure than thinner objects like ropes, spars, yards and masts, totaling an equal projected area.

If the cylinders rotate, the wind pressure increases in a steep curve. The peculiar fact has been found, however, that after reaching a force of about 5,000 kilograms per square meter (about seven pounds per square inch) at a velocity of 40 feet per second, the wind pressure does not increase further but remains almost stationary.



Redrawn from "The Engineer"

DIAGRAM OF THE MAGNUS EFFECT

The wind and the rotation being as shown by the arrows to the left, the excesses and the deficiencies of air pressure are as indicated by the plus and minus signs. The other arrows mark the resultant forces

Herr Flettner stated that by using light metal like duralumin for the superstructure, the weight of the equipment over deck can probably be reduced to one-half of its present weight. The question of stability is one, Herr Flettner said, which is completely under control, as the wind pressure on the stacks is a function of their revolving speed. Should the ship become too cranky in heavy storms all that is required is to reduce the rotation of the cylinders or to stop them entirely.

As a matter of fact the pictures presented to the audience showing the trial trips of Flettner's ship showed it riding on an even keel in rather a stiff breeze when all other sailing craft in the vicinity were noticeably heeled over. This may be due, however, to the fact that the force of wind pressure on the Flettner ship acts at a right angle to the direction of the wind, as has already been explained. A wind dead on the beam, therefore, has the same effect as a quarter wind in an ordinary sailing vessel. As the force of the wind pressure then acts in the direction of the longitudinal axis of the ship, there is no pressure at all on either side.

The navigation of the ship is simple. It is not steered with the rudder alone. The rotors are controlled from the bridge and take an important part in it. To turn the ship in the wind the front rotor is stopped and the rear one reversed. The whole ship can be reversed instantly by reversing the rotation. Deviation from the course can be corrected by adjusting the relative speed of rotation of the two cylinders. The practical limit for tacking was stated to be three and one-half points.

What Will She Do in a Storm?

There are, however, a number of obvious disadvantages. The rotating speed of the heavy and gigantic circular stacks surely has its limitations. Apart from the doubt of how these cylinders will behave in gales, with an enormous pressure thus created on their bearings, it is extremely uncertain that their circumferential speed can safely be kept three and one-half times as large as the velocity of wind in all kinds of weather.

It appears, therefore, that the ship cannot fully utilize strong winds. It is further handicapped in light weather on account of its comparatively low rigging. Another disadvantage seems to be that the wind pressure acts at right angles to the direction of the wind. In a course dead before the wind the propelling power would be almost nil. The ship would then have to tack or to run with cylinders at rest using their projected area as sails.

After-beam winds, in the case of the Flettner ship, produce the same effect as before-beam wind in ordinary craft. The most favorable wind is one dead on the beam. The quarter winds correspond with before-beam winds.

Further developments will show how these disadvantages, of which there are many more than suggest themselves at first sight, can be overcome and how fully they are counter-balanced by the merits of the invention.

Our Point of View

Misleading the American Public as to the Navy

THE present agitation over the supposed weakness of the American battleship fleet, as determined by the Washington Treaty, is nothing more nor less than a discreditable attempt to fool the American public. Apart from its serious effect in stirring up that very spirit of international suspicion and strife which the late President Harding attempted to allay by the Treaty, this agitation takes on a very serious aspect because of the cumulative evidence that its source is to be found in the American Navy —not in the whole American Navy, thank God, but in a, let us hope, very small minority.

Ever since the Treaty was completed the American public has been told either directly or by implication that the United States got a "raw deal" at that Conference, and that not only was the 5-5-3 ratio never established but that we came out of the Conference with our fleet considerably less in power and efficiency than the British fleet and not so very much stronger than the Japanese. Now, the American fleet is the property of the American people, paid for by their money; and the personnel of the fleet has been educated and its salary is paid out of the pockets of the American people. Hence, when the government, as in the case of the Washington Treaty, has inaugurated a definite policy, it is the duty of the officers of the navy to endeavor to follow that policy through to the very letter.

Our Fleet Is Not Inferior

When, as in the present case, a considerable body of these officers endeavors to fool the public by telling them that they possess a fleet inferior to that of Great Britain, and but little better than that of Japan, they are not only violating the spirit of the great school at Annapolis at which they were trained, and the traditions of the navy in which they serve, but they are doing a most injurious dis-service to the American nation.

The writer, after thirty years close study of our navy, during which he has endeavored so far as his pen might serve, to support the navy in its effort to get adequate appropriations, and has lived in the closest touch with its personnel, claims to have acquired a rather acute perception of the difference between a naval article written in the navy and one written by an outside layman; and he is free to confess that, during the years which have intervened since the conclusion of the Washington Treaty, he has been greatly disturbed by his conviction that the propaganda to discredit that Treaty has been written very largely in the navy itself, and when it has not been so written, has found its source of inspiration therein.

America Got No "Raw Deal"

Now, by way of counteracting this misinformation, we beg to state that it is our opinion, and always has been, that so far from America getting a "raw deal," we came out from that Conference with the strongest battleship fleet of the three powers concerned, with a decided superiority on all but one point of comparison over that of Great Britain. This conviction is based on the following facts:

First; in the vital matter of age, the average age of the first ten ships of the United States Navy is five years; whereas that of the British first ten ships is 8.2 years; and it is well understood in naval circles that there is a steady depreciation of a ship as the years pass by.

Second; the average displacement of the first ten ships of our navy is 32,120 tons; whereas the average displacement of the first ten ships of the British Navy is 27,762 tons. There is no truer measure of the value of two ships than displacement. One designer, in distributing a ship's displacement, will favor heavy batteries, another heavy protection, another elaborate underwater subdivision; and another high speed and so forth; but, in the total result, a ton of displacement is of about equal value among first-class navies as built by the world's best designers. So here, also, we find the United States holding a big lead of between 4,000 and 5,000 tons per ship.

We Have Five, the British Have No Post-Jutland Ships

Thirdly; the battle of Jutland taught many lessons, and the British gave to our designers everything they learned in their four-and-a-half years of fighting. We have embodied this and our own information in our first five ships, and three of them (of the Maryland class) have five separate hulls as a protection against disruption by the torpedo. The recent tests of the *Washington* which failed to be sunk by below-water detonations of high explosives, proves that these first five ships are practically unsinkable—they are true post-Jutland ships. On the other hand, not a single ship of the British embodies the full lessons of the Jutland fight; they were built before that fight. It is probable that few, if any, of them have better under-water protection than the *Ostfriesland* which was sunk by a single large bomb dropped from an airplane.

Fourthly; in the matter of guns—we are speaking now of the two fleets as they actually exist today, and do not include the *Nelson* and *Rodney* now building—our first ten ships carry twenty-four 16-inch guns and eighty-four 14-inch guns, making a total of 108. The first ten British battleships carry only eighty 15-inch guns, a weapon greatly inferior in range and power to the 16-inch. Moreover, in the whole 18 ships of the United States fleet of battleships there are 192 main battery guns. In the British fleet of battleships, as it stands today, there are but 160 heavy guns with twenty-eight on the four battlecruisers. On the completion of the *Nelson* and *Rodney* the British will have eighteen 16-inch guns to our twenty-four; and since they must scrap four of their older, 10-gun ships, the totals in heavy guns will be United States 192, and British 166.

Thus far in our consideration of the first ten ships of each fleet we have established a decided superiority for the American fleet. As to the other eight ships, there has been more misleading—we had almost said silly—propaganda sent broadcast through the daily press than in respect of any part of this disreputable controversy. We have heard a great deal about the disparity in range, and we have been told that the superiority of two or three thousand yards of some of the older British ships over our older ships is such that we should be hopelessly beaten in an engagement. The smallest range of the older of our ships is about twenty to twenty-one thousand yards, and we most emphatically assert that the experience of the fighting of the great war, and even the theoretical developments of target practice since the war, fail to give any reason to expect that ships of the future will fight at anything like twenty thousand yards range. As we have noted recently in these columns, Admiral Beatty had an advantage of some three or four thousand yards over the Germans. Nevertheless, at the Dogger Bank fight he did not fire a shot until he was within eighteen thousand yards, and in the battle of Jutland where he had the same advantage, he did not open fire until the same range of eighteen thousand yards was established; moreover, most of the fighting of the battle of Jutland was done at ranges of from twelve to fourteen thousand yards. It is all very well to go out in calm weather under the clear blue skies of the Caribbean or the Western Pacific coast, and open up on a target at twenty to thirty thousand yards, correcting the range by one's own airplanes, flying unmolested above the target ship, but it will be quite another thing to attempt the same thing in the precarious weather which exists on all the seven seas, and when our spotting planes are tied up in a fierce dog-fight with the planes of the enemy. Not one day in fifty will afford weather for that kind of fighting. As at Jutland, the contending fleets will draw in until the "spotters" on the mast-tops can, so to speak, see the whites of each others eyes, as they watch and record the fall of the salvoes.

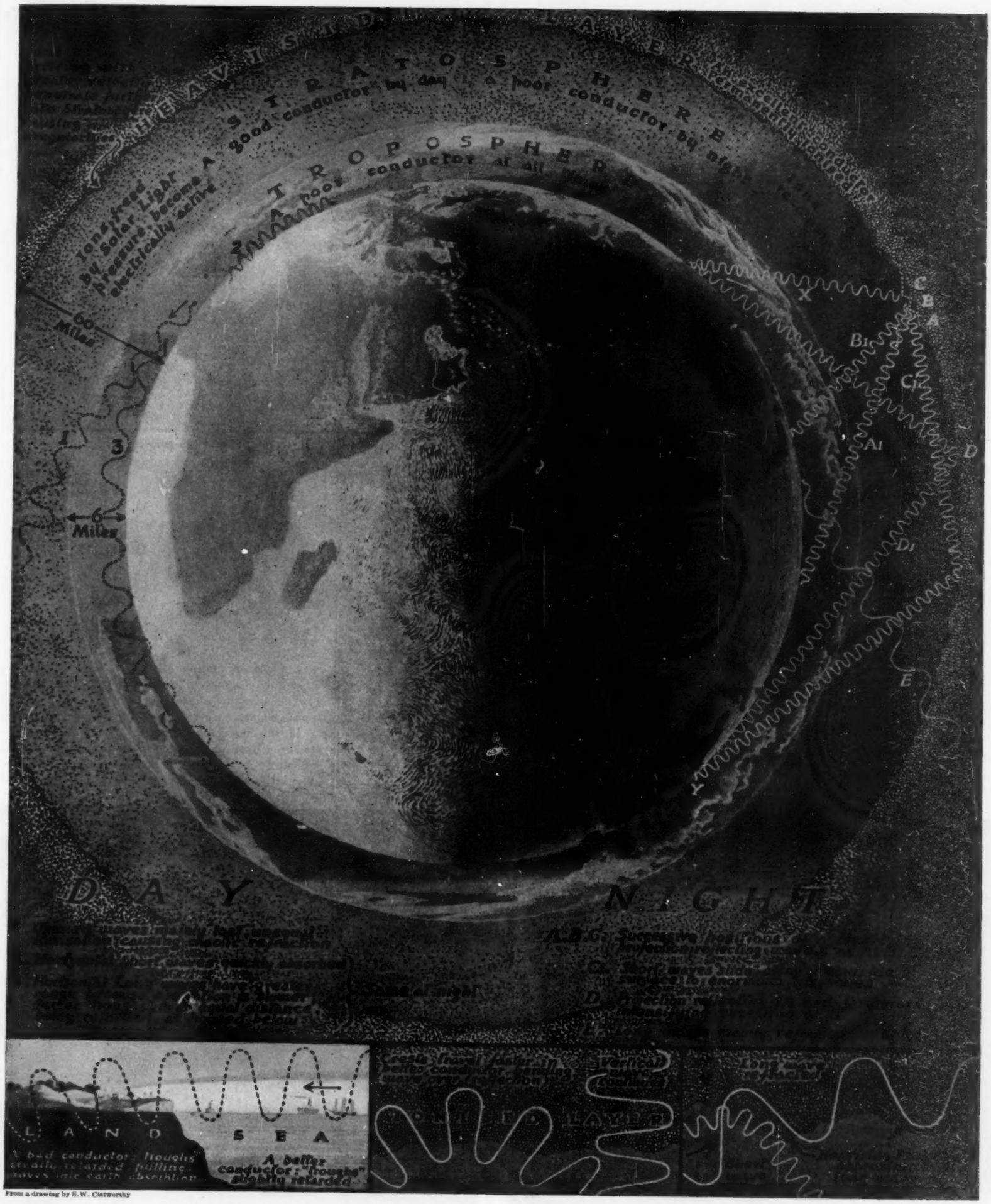
Our Older Ships Not Obsolete

But no attempt to fool the American public as to the inefficiency of our fleet equals the statement that several of our older ships are *obsolete* because on a certain occasion they were able to make only ten knots, due to faulty boilers. If this was so, it was a great reflection upon the engineering staff of the home navy yards and of the ships concerned. Boilers eight or ten years old should be in practically as good condition as when they were new. If not, how came it about that the old *Mauretania, carrying her original Scotch boilers seventeen years old,* was recently able to go out and break a record of fifteen years standing by steaming over the Atlantic at 27.25 knots? If our boilers are deteriorating for want of funds for repairs, let us lay off two or three ships instead of attempting to keep the full fleet in commission, and so have available out of our $300,000,000 or more annual appropriations sufficient funds to keep this vital element of the ships in first-class condition.

Agitation Endangers World Peace

Finally; we repeat, and we defy successful contradiction, that the American battleship fleet today is more powerful and, if properly maintained, is more efficient than any other fleet afloat. And we take this opportunity of expressing the hope that the government will see to it that this misleading, most dangerous and unprofessional agitation is entirely suppressed. If investigations are to be made, we suggest that the government might find it to its advantage to look into the activities of the Office of Naval Intelligence during the years which have intervened since the gathering which formulated and put through the Washington Treaty.

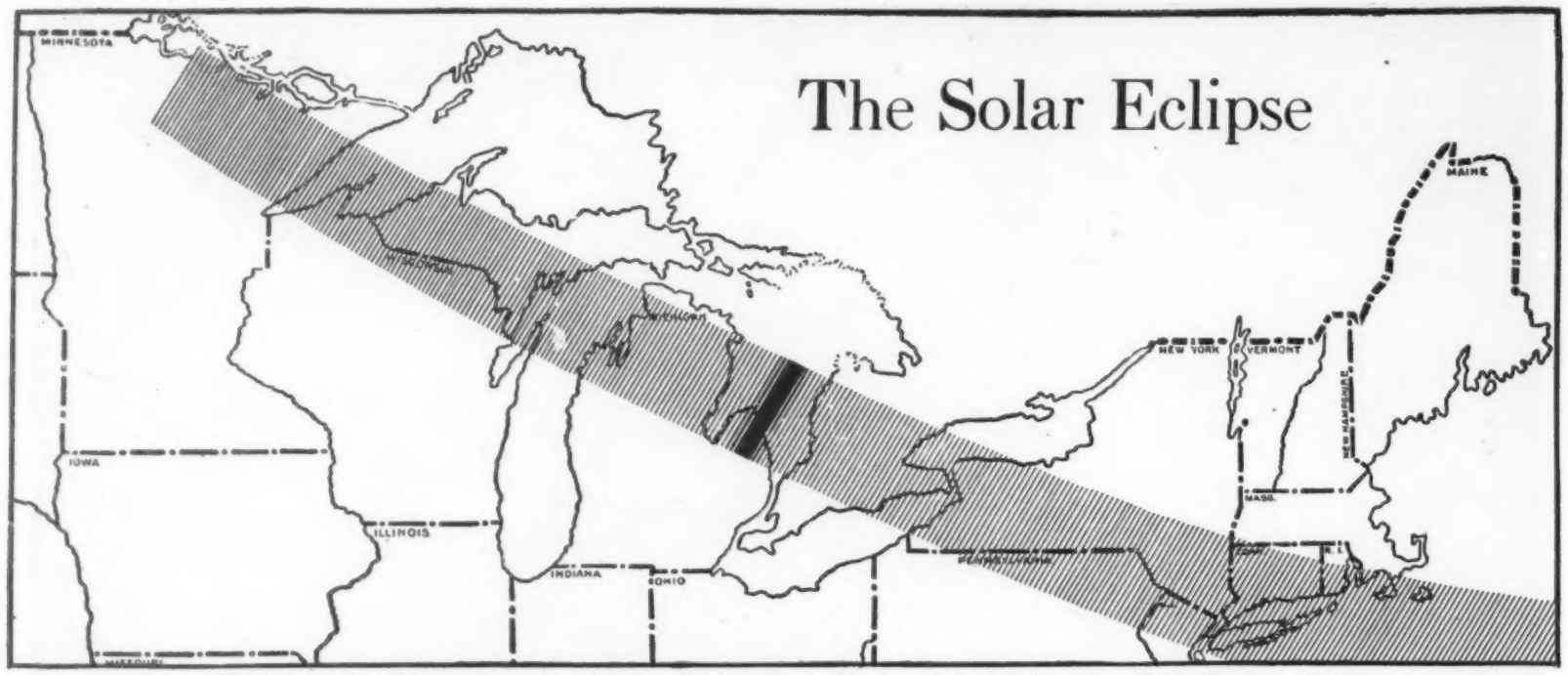
J. B. W.



From a drawing by S. W. Clatworthy

Some Radio Mysteries Which the Eclipse Investigation May Help to Explain

Radio waves go farther than the usual theories predict, especially at night. They lose less energy on the way. Some scientists believe that these effects are due to the supposed Heaviside Layer of conducting gases high up in the air, as illustrated in this drawing. Other experts believe that the Heaviside Layer does not exist. There are other mysteries of radio transmission; for example, the marked difference between night and day.



The shaded strip on this map shows where the eclipse will be total. At the center of the strip the totality will last about two minutes

WITHIN a few days after this issue of the Scientific American reaches our subscribers the long-heralded eclipse of the sun will be on. The date is Saturday morning, January 24. A time table for the period of totality is printed here.

If you live in or near the zone of totality, within which zone the sun's light will be entirely cut off for two minutes or less, and if you are at all interested in doing scientific work yourself, you have doubtless planned long before this just what observations you will carry out.

A number of cooperative investigations, all of them possible without extensive training or complicated equipment, are engaging the efforts of thousands of interested persons in the eclipse area. One of these is the determination of the exact position of the edge of the shadow path, as requested by the American Astronomical Society. The coupon for reporting the results of these observations, as described in detail in our January, 1925, issue, is reprinted in the present issue on page 139.

Another investigation is that of radio transmission during the eclipse, as arranged by the Scientific American with the collaboration of several broadcasting stations and a large group of radio listeners who have registered with us.

This, too, was described in detail in our January, 1925, issue and similar descriptions have appeared in many newspapers in the eclipse zone.

If you have not seen these descriptions and if it is still not too late for you to arrange to help, get a copy of our January issue at a library or book store, or telegraph us to send you our eclipse pages.

The map and time table on this page will show you when and where to begin your observations.

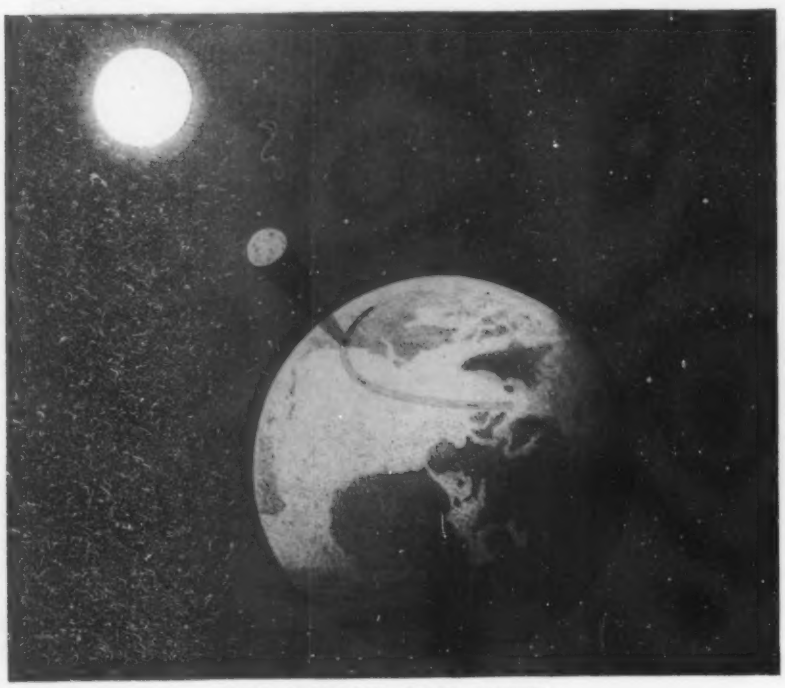
If you make observations of any kind relating to the eclipse send your report to the Editor of the Scientific American, 233 Broadway, New York City. We will see that they reach the proper agency.

The Time Table

This table gives the approximate time of the beginning of totality as calculated for a number of cities in and near the shadow.

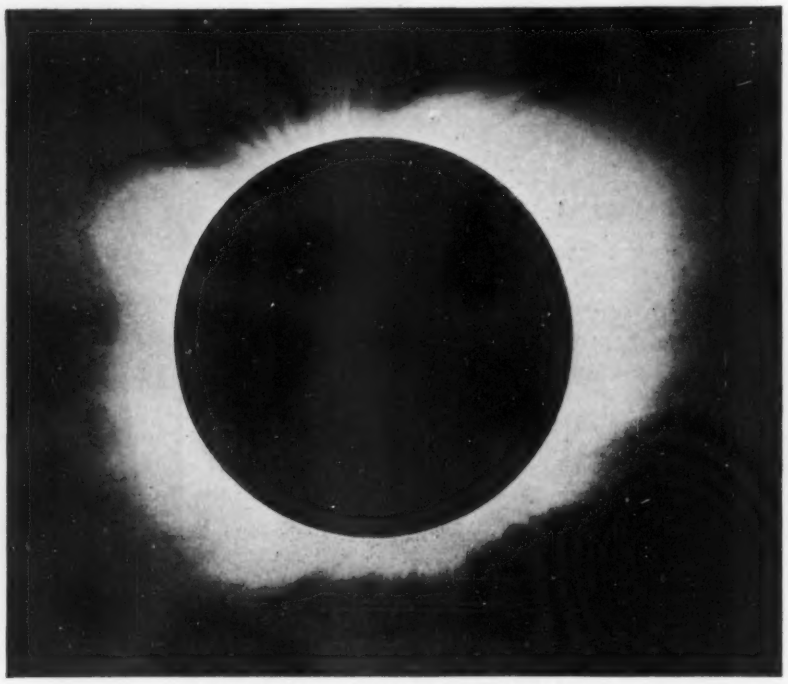
All times are given in Eastern Standard Time. For places that use Central Standard Time, the local times will be one hour earlier.

	Beginning of Totality	*Duration of Totality in Minutes*
Duluth, Minn.	*9:02 A.M.*	*0.4*
Iron Mountain, Mich.	*9:03 A.M.*	*1.7*
Bellaire, Mich.	*9:04 A.M.*	*1.9*
Stratford, Canada	*9:05 A.M.*	*1.8*
Buffalo, N. Y.	*9:06 A.M.*	*1.8*
Warsaw, N. Y.	*9:07 A.M.*	*1.9*
Hornell, N. Y.	*9:08 A.M.*	*1.4*
Ithaca, N. Y.	*9:09 A.M.*	*1.8*
New York City (northern part)	*9:10 A.M.*	*.5*
Poughkeepsie, N. Y.	*9:11 A.M.*	*1.9*
New Haven, Conn.	*9:12 A.M.*	*2.0*
Montauk Point, L. I.	*9:12 A.M.*	*2.0*



HOW THE ECLIPSE IS CAUSED

The moon gets between the sun and the earth, casting a complete shadow which moves along a narrow strip as the earth revolves



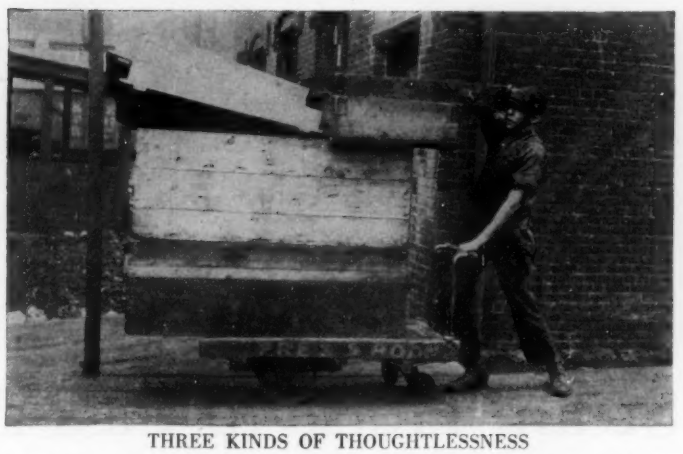
WHAT THE ECLIPSED SUN LOOKS LIKE

Around the black disk of the moon is the marvelous fringe of light or "corona" that astronomers will travel miles to see

Watch Your Step!

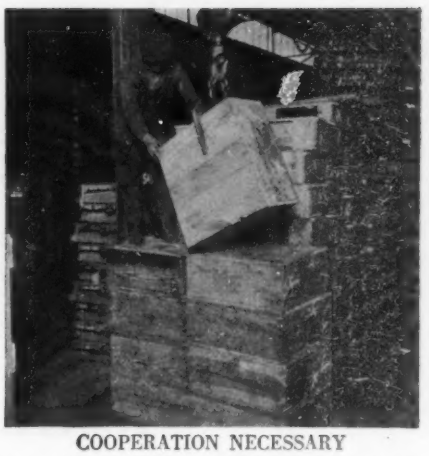
USE THE PROPER TOOL

This man used a piece of rusted out pipe instead of a solid bar. In such cases the burden of proof is not always with the man but with the supervisor who fails to see to it that the proper tool is available



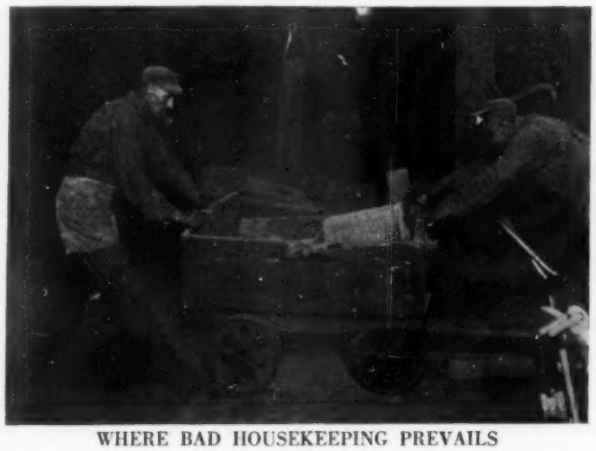
THREE KINDS OF THOUGHTLESSNESS

In the first place the man should be pulling the truck instead of pushing it. Then it would be unnecessary for him to look over the load. In the second place he has piled the load too high for safety and in the third place the safety committee has neglected its duty in recommending the removal of the unnecessary post in the runway



COOPERATION NECESSARY

A combination of care on the part of the craneman in the cab overhead and the man on the pile stacking boxes for shipment would save trouble here. A slip on the part of either will result in a dangerous fall for the "Hooker"

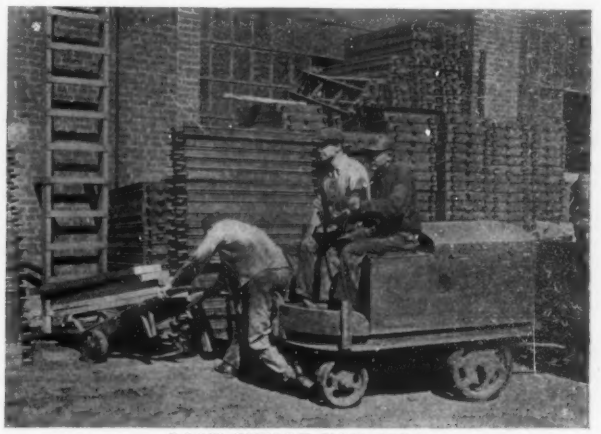


WHERE BAD HOUSEKEEPING PREVAILS

The man on the left is shown in the act of tripping over a piece of wire thrown on the floor by some thoughtless worker and left there by an even more thoughtless one. The wire is holding his foot in a position to be run over by the wheel of the truck

DANGER AHEAD

"Look where you're going!" "Go where you're looking!" is a good slogan to keep in mind. In preventing accidents, everyone counts



LOOK BEFORE YOU STEP

The man pulling the hand truck did not look around before stepping out into the gangway and the tractor driver failed to sound his signal when he saw the man working behind the piles of flasks. Cooperation works wonders in preventing unnecessary accidents

HEEDLESSNESS AND NEGLIGENCE

Two parties were concerned in the kind of carelessness this picture portrays. The man is unmindful of the fact that his foot is under the floor of the runway and the man who constructed the platform failed to board up the end

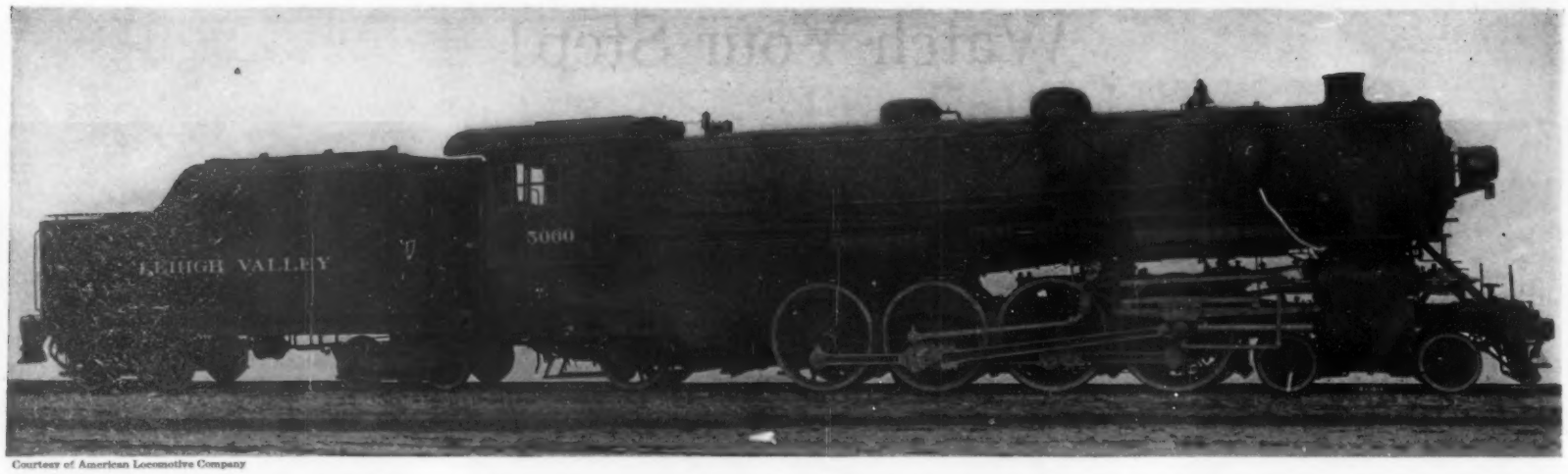
FEET WERE NOT MADE FOR BRAKES

Proper methods are most necessary when handling heavy objects on hand trucks. The picture illustrates how a man was injured when he tried to brake the wheel of the truck with his foot. In handling such heavy objects, blocks should be placed behind the wheels or, failing that, a mechanical brake should be installed on the truck

A FIRM FOOTHOLD NEEDED

Indicates carelessness on the part of the man wheeling the barrow and also the man who failed to cover the pit completely so as to give the man a firm foothold. The man wheeling the barrow failed to balance his load properly

The above photographs were taken under the supervision of W. F. Sterne, Safety Engineer for the American Radiator Company



Courtesy of American Locomotive Company

Is the Steam Horse to Pass Away?

One New Type of Locomotive Has Three Cylinders Instead of Two. Its Advantages May Keep Steam at Work on Our Railways in Spite of Competition from Other Forms of Traction

By Albert G. Ingalls

HOW many times have you heard people say that within a few years something wholly different and better will take the place of the steam locomotive? "It is only a matter of time," they tell you, "when those who want to see a steam locomotive will have to visit the National Museum." And these people believe what they say.

If you ask a railway official what he thinks about it, the chances are his answer will run something like this: "Well—you and I need not worry about that change during *our* lifetime." And this man, too, believes in what he says.

Is the railroad man too close to his daily work to have perspective? Is he simply impervious to new ideas, or, is the man who thinks the steam locomotive is a hang-over from a by-gone age indulging in snap judgment?

There are those who know all about the marvelous evolution which the steam locomotive has recently gone through, but there are many more who know only that it has grown very much larger than it used to be.

The fact is, that from year to year with a steady increase in size or weight, the locomotive has also been improved in its overall efficiency.

To illustrate, let us make a comparison between a representative large locomotive of twenty years ago and a representative large one of today. Back in 1904 there was a new type of locomotive on the Pennsylvania Railroad known as the 2-8-0 class. These engines weighed ninety-seven tons and developed 1,000 horsepower. Therefore, it took 200 pounds of locomotive to develop one horsepower.

Today the Pennsylvania Railroad has a type of engine called the 2-10-0 class weighing 185 tons which develops 3,500 horsepower. Therefore, it now takes only 105 pounds of locomotive to develop one horsepower. Two hundred pounds against about one hundred pounds—here is a gain of almost one hundred percent and this gain certainly cannot be credited merely to the increase in size of the locomotive. It is a gain in quality as well.

Again, take the modern locomotive from the point of view of thermal efficiency, that is, the amount of ear-pulling work that can be got out of the pound or ton of coal burned under the boiler. Since 1904 the thermal efficiency of the modern reciprocating locomotive has increased by over fifty percent. That means that a ton of coal now goes as far as a ton and a half went twenty years ago.

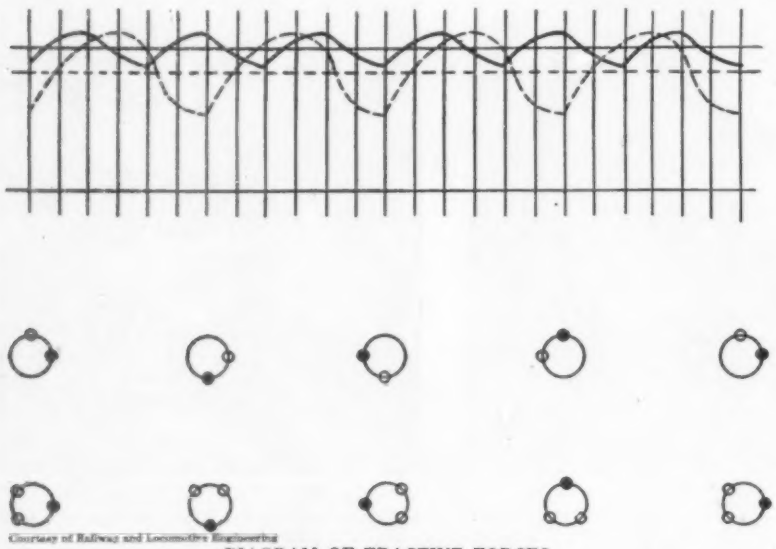
These two great outstanding gains in overall efficiency were made during a phase of the evolution of the locomotive when there were two ways to get more locomotive results. One way was to make the locomotive larger, the other was to make it better.

Today, however, we have reached the practical limit in locomotive size. Therefore the logical thing to expect in the future is a still more pronounced evolution in locomotive quality. This is the only remaining outlet for efforts directed toward making the locomotive draw more freight.

Just what accounts for the general, overall efficiency increase of the past two or three decades is one of the things that is hard to put your finger on. By that I mean there is no one decided cause, but many. Here are some of the factors, placed purposely in shuffled order since there is much disagreement concerning which ones are the most important.

Superheated steam
Pre-heated feed water
Improved valve gears
The thermic syphon
Forced-feed lubrication
The booster
Improved boiler design
The firebrick arch
The three-cylinder engine

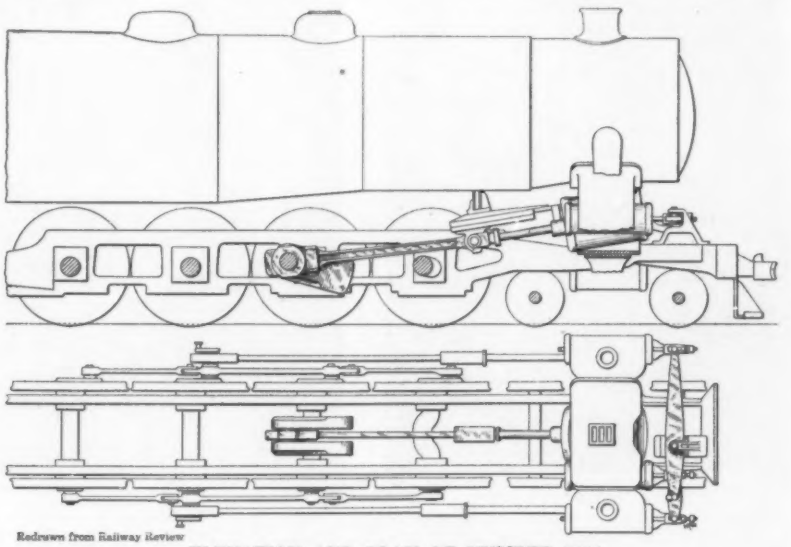
Just what, in a few words, is superheated steam



Courtesy of Railway and Locomotive Engineering

DIAGRAM OF TRACTIVE FORCES

The dotted curve represents the pulsating tractive forces of the two-cylinder locomotive. The black line curve represents the much steadier tractive force of the three-cylinder locomotive. Thus, by the use of the third cylinder the mean tractive power is raised from the dotted straight line to the solid straight line



Redrawn from Railway Review

ELEVATION AND PLAN OF NUMBER 5000

The outside cylinders are omitted from this drawing. Nine degrees slope was given to the center cylinder in order that its connecting rod might clear the front axle. All three cylinders are identical in bore and stroke and all three take steam at the same pressure. Thus, Number 5000 is not a compound locomotive

and why is it better than plain steam? In the old-style engine without superheat you simply filled the boiler partly full of water, built a fire in the firebox and you got steam. In a superheating locomotive, instead of conducting the wet steam from the boiler straight to the cylinders, it is run through a pipe to a coil situated where it gets some of the waste heat that used to go up the smokestack. There it is heated still more. The steam will continue to get hotter and hotter, but it cannot take up any more water because it is no longer in the boiler where there is water for it to take up. You can go on heating this steam until the pipes in which it is conducted glow red. This is superheated steam, and when you now conduct it to the cylinders of the engine you not only get very much more work out of it, but you discover that it no longer condenses in the cylinders thus possibly causing all sorts of trouble there. Modern reciprocating locomotives superheat the steam up to 600 degrees, Fahrenheit.

The feed water pre-heater uses waste heat from the exhaust of the engine to warm up the water before it is put into the locomotive boiler. The saving thus made is perhaps five percent.

The thermic syphon is a new attachment to the boiler but it has already been applied to some fifteen hundred modern locomotives. By providing a return path or circuit, permitting the water in the boiler to keep circulating past the hottest part of the fire, it promotes efficiency through promoting faster evaporation of the water into steam.

Forced feed lubrication, of course, simply does for the locomotive what it does for your motor car, it helps cut down friction losses.

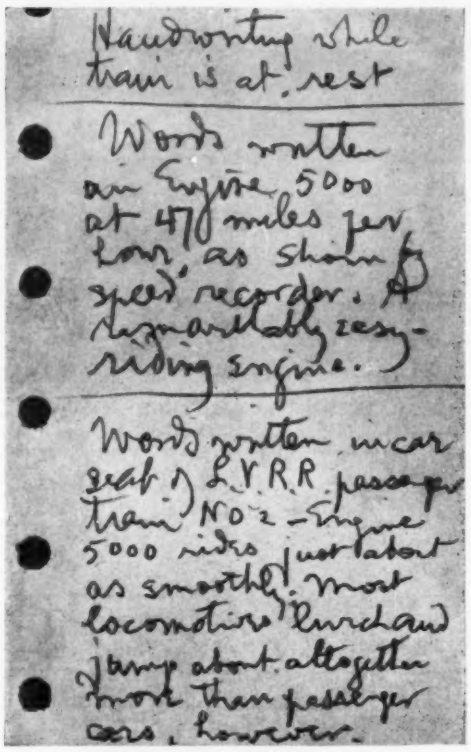
The booster is an interesting attachment which has been developed since the war. It is simply an auxiliary engine consisting of two cylinders mounted on the pair of trailing wheels under the rear of the locomotive. It works only at low speeds where extra boosting is needed for starting heavy trains or helping them climb steep grades. The booster adds about twenty percent of extra muscle to the locomotive.

The firebrick arch is a sort of baffleplate consisting of an arch of firebrick built across the firebox in such a position that it holds back the flame so that it can evaporate more water into steam.

Perhaps the most significant of our modern locomotive advances is the first successful development in America of the three-cylinder locomotive.

There is nothing deeply involved or complicated about this new development. Simply, instead of the two cylinders which one finds on the average locomotive there are three. These three cylinders are all practically alike, they all use steam at the same pressure and there are three evenly spaced power thrusts in each direction.

The three-cylinder locomotive is in no sense a compound engine. Two of its cylinders are placed identically as the cylinders are placed on the ordinary two-cylinder locomotive, but there is an additional cylinder in the center, its connecting rod attaching to a crank bearing in the center of one of the drivewheel axles.



HAVE YOU EVER RIDDEN A LOCOMOTIVE?
The three cylinder engine rides much easier because its moving parts can be balanced much better

The advantages of the three-cylinder locomotive are: more power, steadier pull, greater economy in the use of steam and more economical combustion of the fuel.

Nearly everyone is familiar with the reason for the advantage the six-cylinder automobile engine has over the four-cylinder motor. The overlapping power strokes give a more uniform torque or twist to the crankshaft. The same principle applies to the three-cylinder locomotive. This even torque is especially valuable for starting heavy trains, as it takes more power to start a train than to keep it going. The addition of the third cylinder also permits an earlier cut-off which effects a saving in steam.

The purring exhaust results in a much steadier draft on the fire than is the case where the more pulsating draft of the two-cylinder locomotive is used. This promotes fuel economy.

At the time when this article is being written there is just one of these locomotives, designed and built as such, in operation in America; but so successful has been the operation of that one locomotive that the eyes of every railroad official in America have been on its performance since it was put in use on the Lehigh Valley Railroad a little over a year ago.

The noted Number 5000 was built by the American Locomotive Company at Schenectady, New York, and is running every day of the week over the mountainous grades of Eastern Pennsylvania on the Lehigh Valley main line. On that line, one of the most important of all trains is the train that brings a part of New York's daily supply of milk from the farms of Pennsylvania and Western New York. That train must get through on time, rain or shine, and it is run on a passenger schedule, the time for its run over the mountains being but six minutes slower than that of the famous Black Diamond Express.

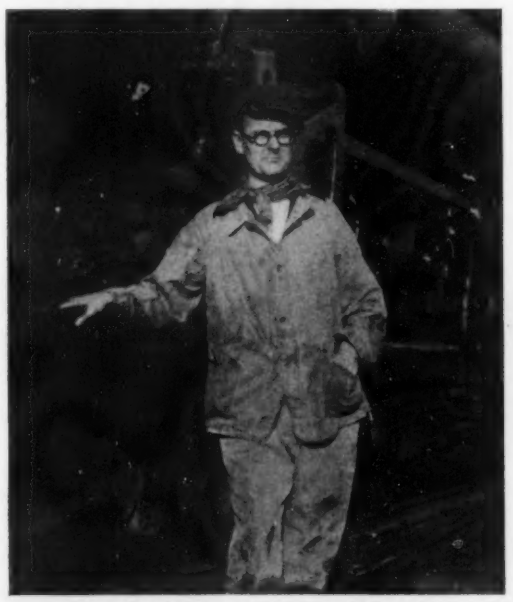
Late in September, 1924, I went to Sayre, Pennsylvania and rode Number 5000 to Mauch Chunk, 145 miles southeast of Sayre, the run taking four hours. I found the Lehigh Valley officials more than pleased with the performance of this new marvel, and that feeling extended to the men who had direct charge of it. I met with a great surprise, not only with regard to the demonstrated high efficiency of the three-cylinder locomotive and its remarkable performances in starting heavy trains on steep grades and its lower fuel consumption, but especially its ease of riding.

This locomotive is really a large passenger engine. Her drivers are nearly six feet in diameter, her weight is 185 tons, her boiler pressure is 200 pounds per square inch, and her tractive effort or pull is 64,700 pounds.

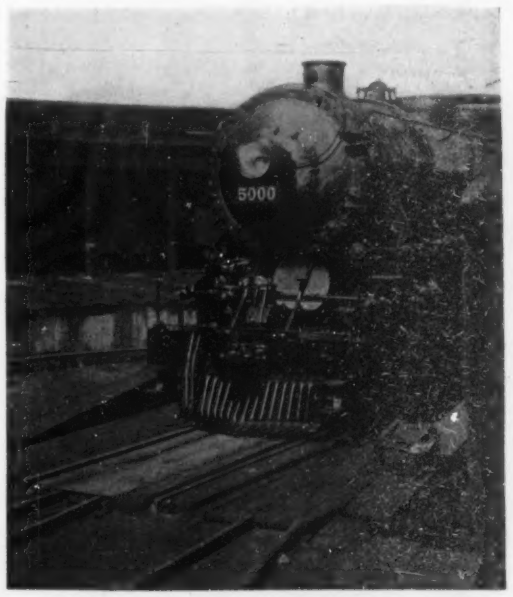
I asked the road foreman of the division on which Number 5000 makes her daily run what the saving in coal, due to the use of the three-cylinder locomotive, amounted to. "Well," said he, "you can figure it this way. Before we got Number 5000 it took one engine and one helper to haul this train. The three-cylindered Number 5000 now hauls it alone and hauls it with less delay. We burn about seven tons of coal for the run. The two-cylinder locomotives that used to haul this train used about two tons more than we do."

Based on the remarkable performance of Number 5000, which has been ridden, studied and closely observed by railroad officials who during the past year have come for the purpose from all over the country, more three-cylinder locomotives are being built by the manufacturer of Number 5000 for the Chicago, Rock Island and Pacific Railroad; for the Louisville and Nashville Railroad; for the Southern Pacific Railroad; for the Missouri Pacific Railroad; ten for the New York, New Haven and Hartford Railroad and five more like Number 5000 for the Lehigh Valley Railroad.

When it is remembered that railroad men are positively hard boiled when it comes to spending money on innovations of unestablished merit, or on stunts and notions, it begins to look as if Number 5000 were destined within a few years to be regarded as the forerunner of a great advance in American locomotive practice.



AN INCONGRUOUS COMBINATION
Railroading togs and the editorial tortoise-shell-rimmed spectacles caused consternation among the Lehigh Valley Railroad employees



THE FAMOUS NUMBER 5000
To get a clear photograph showing the head of the third cylinder and its piston valve, these parts were painted white for the occasion

International

IT THROWS A TON OF STEEL

This new sixteen-inch gun is one of two at Fort Tilden, New York

Wide World

ROADS OF BUILDING BLOCKS CONQUER SAND

In Imperial County, California, is this highway made of bolted timbers

Hans Herzberg

FLYING SKATES GIVE NEW THRILL

Ball-bearing, rubber-tired skates with large wheels permit fast cross-country racing in newest German sport

Department of Agriculture

KEEPS TAB ON FARMER'S FIELDS

This tabulator is used by experts of the Department of Agriculture in making surveys of crop condition

Kadel & Herbert

AIR FLIVVER CARRIES FAMILY

Recent German progress in the design of small aircraft is evidenced by this plane

General Electric

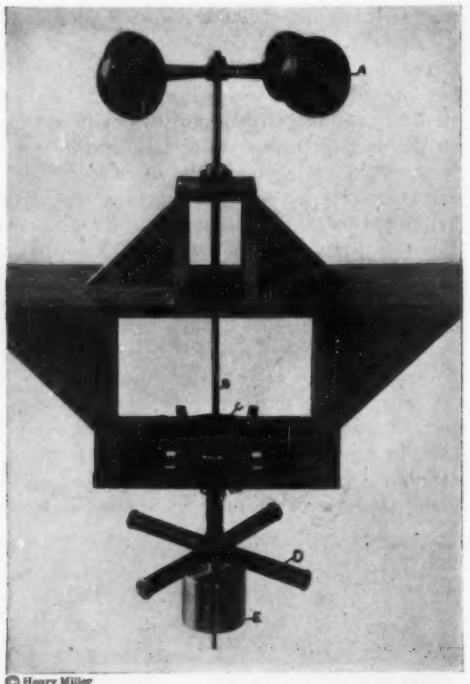
WINDOW ADMITS FULL SUNLIGHT

These panes of clear, fused quartz permit passage of the active ultra-violet rays

Wide World

HOW FAR WOULD YOU WALK FOR THIS?

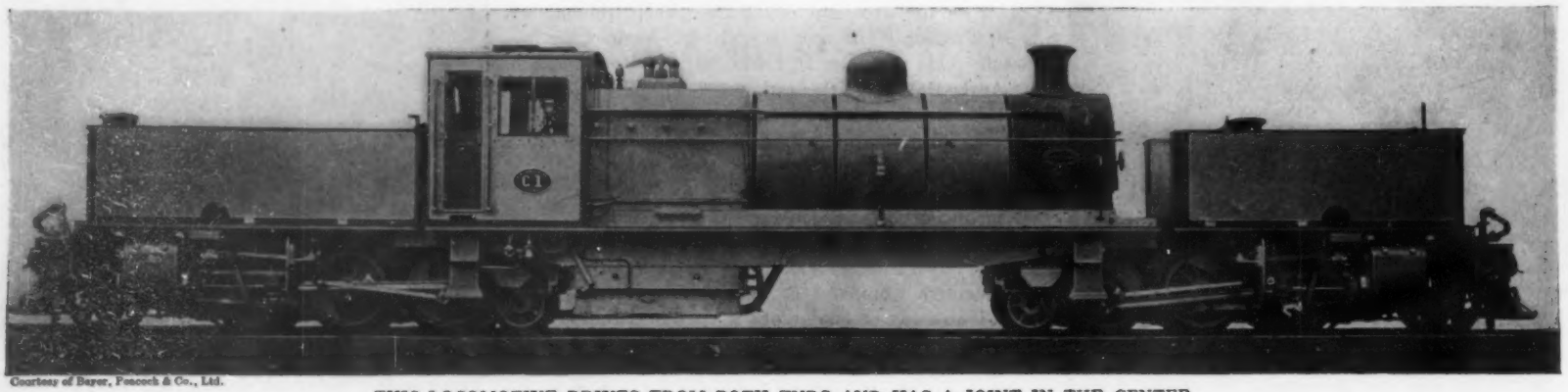
Central European gardeners are developing great skill in decorating hedge-rows in this unusual way



© Henry Miller

COMPASS DOES NOT USE MAGNETISM

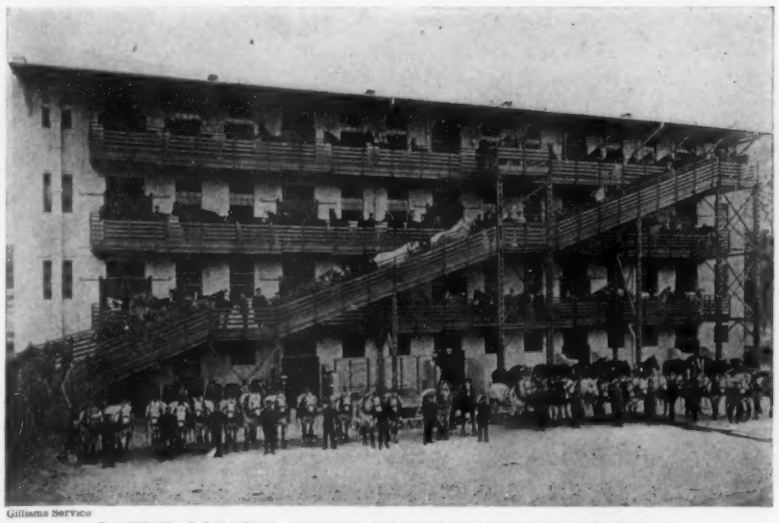
This is the earth inductor compass developed by the Bureau of Standards



Courtesy of Beyer, Peacock & Co., Ltd.

THIS LOCOMOTIVE DRIVES FROM BOTH ENDS AND HAS A JOINT IN THE CENTER

On the New Cape Central Railway of South Africa a combination of high grades and sharp curves necessitated the design of this special locomotive



Gillisms Service

LATEST LODGING HOUSE PROVIDES EQUINE COMFORT

In this new hotel for horses in Berlin the guests may even take an airing on the balconies

Illustrated London News

A ROMAN LEGIONARY'S MAP

This fragment with list of marching stages was discovered near Damascus

Wide World

FISH SCALES GIVE AID TO BEAUTY

Expensive artificial pearls are now made by coating beads with a solution made from herring scales

Gilliams Service

UTILIZING POOR LITTLE BUTTERFLY

The above lace-like tray is made up entirely of butterfly wings in all their beautiful colors

Pacific and Atlantic

NEW CABLE BREAKS SPEED RECORDS

The cable recently installed between Long Island and Italy will carry 1,700 letters a minute

Wide World

INVENTOR WALKS ON WATER

Seamless tubes made in the shape of thick skis permit rapid movement over the water

Wide World

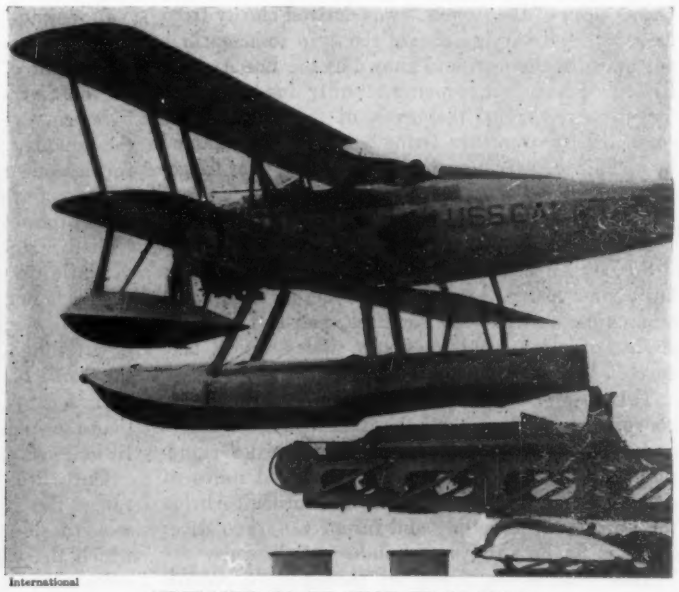
CLAY PIPE TO TEST EINSTEIN

The University of Chicago will test relativity by light rays through a vacuum in pipes

Pacific and Atlantic

EARTH QUIVERS TO BE RECORDED IN NEW YORK

Father John S. O'Connor of Fordham University is to have charge of a new seismic station installed to keep earthquake records in the area of New York City



International

AIRPLANES TO BE SHOT FROM SHIPS

The Navy Department has installed on the U.S.S. California one of the new catapults by which a seaplane can be launched from the deck

Leading a River Across the Desert

The Newest Plan of Los Angeles Engineers to Provide More Water for that Enterprising Metropolis

By Captain Edward C. Crossman

NINETEEN years ago a flourishing and progressive Southern California hamlet, with a population of nearly 200,000 souls, proceeded to vote bonds for $25,000,000 for what was looked upon by many as a crack-brained scheme to build about 250 miles of aqueduct to convey water from a river of the High Sierras.

The water supply, which was found adequate when the first Spanish soldiers had founded the hamlet and called it by the poetical name of "Our Lady Queen of the Angels," was derived chiefly from the small and varying stream rising in some springs northwest of the city, and known as the Los Angeles River. It had been proving steadily inadequate as the city grew, until the needs of the municipality compelled the ranchers living in the region drained by the little river to stop all pumping for irrigation and to let their crops go hang.

City Threatened by Drouth

So Los Angeles voted the bonds. Her engineers built some 250 miles of aqueduct across desert and mountains, and the city sat back, satisfied that the stream of clear, cold, mountain water would take care of her needs indefinitely.

This year of 1924 finds the same city of the angels conspiring with other Southern California cities to end an impossible situation from the water standpoint and to build nearly three hundred miles of aqueduct across a burning desert in order to bring the waters of the muddy and far-off Colorado River into the fertile valleys of Southern California.

This year is the driest on record since records first began, not only from the standpoint of actual rainfall during this and the two years preceding, but because there are so many more people to use what water is available.

The hamlet has grown from its 200,000 to more than a million, and the outside towns and the country have grown in proportion. Town after town has climbed into the Los Angeles band wagon to get its share of the Owens River water supply and thus end an insufferable condition.

With San Francisco reaching steadily southward for its share of the Sierra water supply, and Los Angeles threatening to convert the Owens River Valley into a desert through its ever-growing demands on the water supply of that region, the end is in sight of the growth of any country depending on the Sierra streams for its supply.

So surveyors have plodded south eastward, and the muddy, wild, rampaging river dividing California and Arizona is in danger of being invited over into the fertile coast valleys of Southern California across the worst desert and wildest mountains in the United States.

While the precise spot of the intake on the great river has not been settled upon, the various tentative routes converge at the foot of a wild, rocky, treeless, desert range known as the Chocolate Mountains at the north border of the Colorado desert, where the water has to be lifted over a summit 1,400 feet higher than the intake of the river. This means a pleasant little desert jaunt of from 80 to 100 miles.

Once lifted over the top of this desert mountain range the muddy water will meander along the western slope of the San Bernardino Mountains, of which the Chocolates are merely an extension, for some sixty miles more when it will turn southwest and dive under the San Jacinto range in a tunnel now planned to be some thirteen miles long.

Running northward on a high line to keep above the country to tap the aqueduct, the water will hug the foothills above San Bernardino and Redlands and then flow westward to the Los Angeles supply reservoirs, caring for the needs of the many towns in the valley between the orange towns in the San Bernardino valley, and the final distribution close to the sea.

The greatest need for the muddy waters of the wild desert river is, of course, among the neighboring towns to Los Angeles, her own Owens River supply still being adequate for her present needs.

Sixty Miles of Tunnels

Building the Owens River Aqueduct was child's play compared with the Colorado project. Starting at 4,000 feet the aqueduct dropped neatly and easily down the desert country to the reservoirs around Los Angeles, less than a thousand feet above the sea.

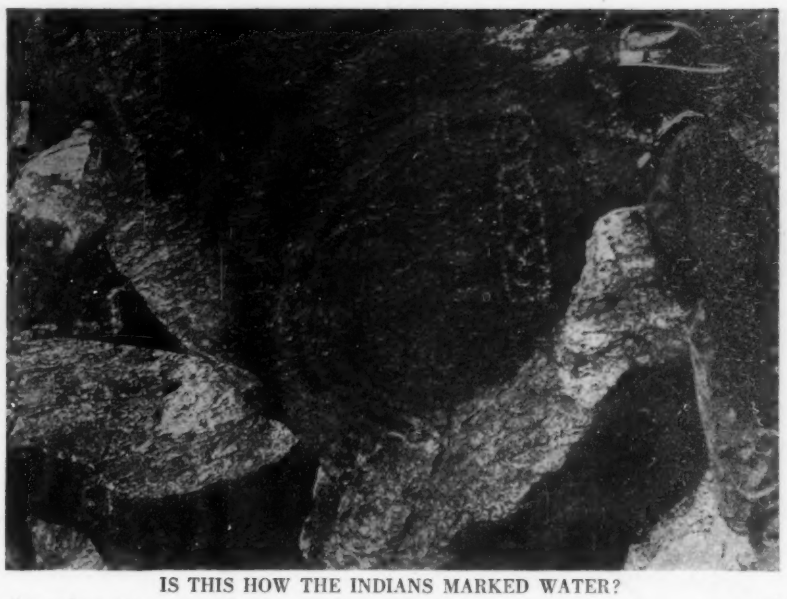
There were some tunnels to be built, some sixteen miles of them, some steel siphons and some reservoirs, a pretty hefty engineering project in itself, but easy in comparison with the project of hoisting the waters of the Colorado from its already low level of around 250 feet over a mountain range a quarter of a mile higher than the intake and then carrying out this increased elevation for a couple of hundred additional miles.

The project includes thirty-five miles of tunnel in crossing the Chocolate Mountains, about fifteen miles of tunnel in crossing the north end of the San Jacinto range and another ten miles above Redlands, the mild total of sixty miles of tunnel.

Engineers approach the Colorado with their hats in their hands, if they have any considerable experience with the stream. The difference between

VALLEYS THROUGH WHICH THE AQUEDUCT WILL RUN

Few deserts in the world are drier and more dangerous than those which the new water conduits must cross



IS THIS HOW THE INDIANS MARKED WATER?

Throughout the desert ancient signs like these are found near water holes, perhaps road markers left by prehistoric travelers

herding a little creek like the Owens River into an aqueduct and driving the Colorado into one, is that little difference between shooing a sheep into a corral and trying to punch a rogue elephant into the same opening.

The elephant may decide to go through, but is quite likely to tear down most of the fence in the process, if he doesn't take apart any nearby buildings into the bargain.

Wild River Broke Banks

Quite a few years ago the wild river happened to look around and notice that certain presumptuous white men had made an opening in its banks and were taking some of its brown water down a series of ancient channels and artificial canals into the Imperial Valley, below sea level, and much below the river, of course. It happened that this valley and the Salton Sea basin was the old mouth of the river in the days when the sea ran that far to the north. So the mighty stream inserted its shoulders into the modest little intake and gave a couple of heaves, and a couple of days later the entire flow of the Colorado was tearing down into the Imperial Valley, which was several million feet per day more than the valley needed or had the least use for.

It required the entire resources of the Southern Pacific, of government engineers and aid, and the prompt action of a Roosevelt to subdue this wild river and crowd it out, and shut the intake gates in its face once more. In the meantime much of the valley went under water and the railroad, well up on the foothills of the Chocolate range, had to take up its tracks or abandon them and make for still higher land.

From an engineering standpoint it is probably the worst river in this country, suffering as it does from a complication of a devilish disposition, a tremendous silt flow, a heavy current, ever-changing banks, and sudden floods that may raise it six feet over night.

The water in its lower stretches, where the Southern California Canal would be taken out, is about the color of *cafe au lait*, without much *lait*. It makes the Missouri resemble a pellucid and sparkling brook, which the Missouri is not from any ordinary standards. Parties having ambitions to drink the waters of the Colorado, draw off a bucketful, let it stand a half hour, and then drink the liquid-half remaining. The other half will grow the cotton or the melons which make the Imperial Valley famous, and which soil was brought in originally by the same river.

Because of this heavy silt content, settling basins have to be built and constant work is necessary to keep them and the canals free from the deposit.

The heavy current and the violent and sudden rises in the river make it necessary for the engineer to watch his step as to where he goes cutting into the banks of this pleasant stream. Ancient residents along its bank allege that it will climb a tree to get around a dam or other obstacle. Certain it is that no ordinary mild dam and ordinary canal departing from its banks is a safe scheme.

Wet Water Is All They Ask

The safe intake, therefore, must be where the river is confined in rocky walls to prevent its cutting around the ends of the impounding dam or crowding into the little canal and carrying destruction to the country along it. There is not much danger of its climbing, unaided, over the 1,400-foot elevation of the Chocolate Mountains and washing the mayor of Los Angeles out of the city hall, but there is danger of a poorly chosen intake site being wrecked or silted up.

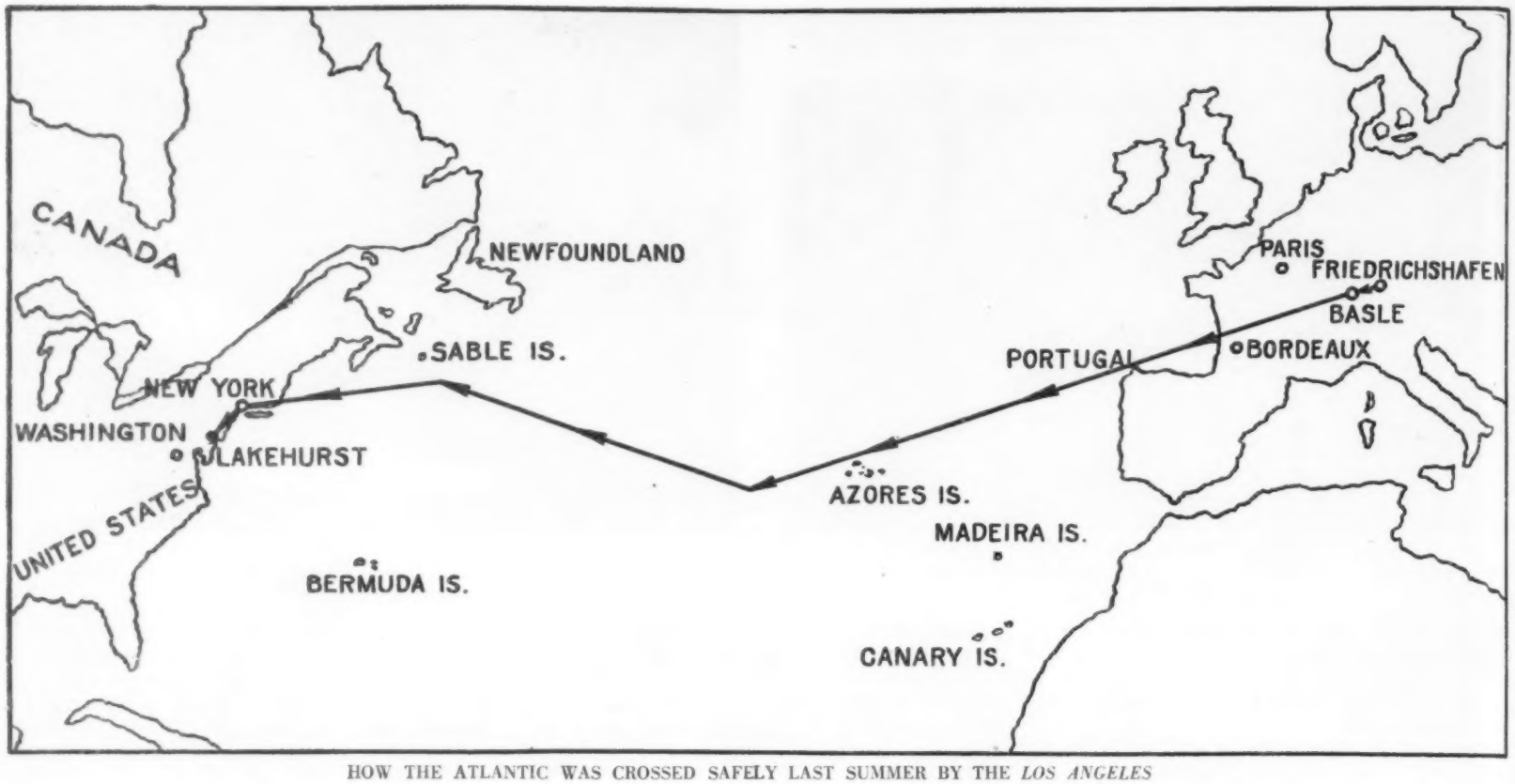
The water will, of course, lose most of its silt on the long trip to the terminus of the canal, but in its highest moments it will not remind any citizen drinking it, of the water just taken from one of nature's sparkling and chill springs. The point is that it will be wet and germ-free, and this is all that is asked of water by the denizen of Southern California.

THE DESERT LIFE-SAVING STATIONS

Holes dug in the sands at favorable places now furnish the desert waters

THE WATER SUPPLY THAT LOS ANGELES PROPOSES TO OBTAIN

This view of the Colorado River in flood shows how vast a supply will be available if the engineering difficulties of the project can be solved. Much of this water is now unused anywhere



HOW THE ATLANTIC WAS CROSSED SAFELY LAST SUMMER BY THE *LOS ANGELES*

Can We Prevent Aerial Holocausts?

The Second of a Series of Three Articles on the Probable Future of Giant Dirigible Airships

By Alexander Klemin
Professor of Aeronautics, New York University

THE greatest danger of dirigible operation is generally supposed to be fire—the public invariably connects the dirigible with an explosion destroying crew and ship instantaneously. Yet during the war the British flew 2,500,000 miles in hydrogen-filled airships with but one fire in the air, and that on a new, experimental ship. And the Germans likewise lost but one ship through fire in the air—discounting fires due to enemy bullets. It is such accidents as the structural failure of the *R-38* and the *Roma* with fire *afterwards* which give an exaggerated importance to fire as a cause of accident.

The Constant Fear of Fire

Fire prevention is nevertheless one of the main problems of the designer of an airship and the constant preoccupation of its crew. Every part of the ship bears the impress of this anxiety. For example, the automatic gas valves of the inner bags, placed low down are protected by ventilating shafts leading the escaping gas vertically upwards clear of the ship. Great efforts are made to keep the gasoline system tight and to prevent accumulation of gas vapor in the great central corridor. Another measure of safety is provided in the use of "slip tanks" for the gasoline which can be immediately released in case of emergency. The cars containing the gasoline motors, guns, wireless and other sources of fire are kept well away from the envelope and the gas tanks; gas leaking into the gondolas is fatal.

Since it is the motors and gasoline system which constitute the greatest danger, the greatest efforts are now being made to develop an engine burning oils, such as kerosene, with a higher flash point, fuels that it is impossible to set alight with matches or even burning paper in an open pool.

The Spark of Death

A wisp of smoke drifts out into the corridor of a hotel. Someone shouts fire. Alarms sound. In a moment there are engines, ladders, brave and experienced firemen to aid the guests to safety.

And yet the ambulances must take away, all too frequently, what is left of three or four unfortunates who were trapped.

How much more terrible is fire aboard an air liner! Nothing underneath. Overhead a giant firecracker filled with instantly explosive gas. A single nail in someone's shoe may strike the spark that sends ship and men hurtling downward to their doom.

No wonder that aeronautical engineers have spent time and money—even lives—combating this devouring hazard of the skies. What they have done Professor Klemin tells in this authoritative article.

The main difficulty in using high flash-point oils, is that it is impossible to atomize them in the simple manner in which a carburetor atomizes gasoline. In a Diesel engine the difficulty is solved by raising the fuel and air to a tremendous pressure, and injecting it at the top of the stroke where the high temperature of the cylinder produces auto ignition. But while the tremendous pressures used—over 500 pounds per square inch—mean a correspondingly high efficiency, such engines with their heavy compressors must be too heavy and bulky for airship use.

A very promising line of inquiry now being pursued in the United States is the injection of fuel through an orifice at a pressure of 10,000 pounds per square inch. The jet of fuel enters the cylinder at the top of the stroke with tremendous power. There is complete vaporization and auto ignition. Since there is auto ignition there is no need for spark plugs and no danger of pre-ignition. Consequently, the air itself can be raised to a compression ratio of 10 to 11, with a corresponding increase in efficiency. Since only the small volume of fuel is itself compressed outside the cylinders, bulky air compressors are avoided. This system may, therefore, offer a very promising solution.

It may also be possible to use heavy oils, but with the addition of a special mechanism for vaporizing and refining the fuel before putting it into the engine, thereby making use of the present high state of development of the gasoline engine and still using the safer fuel.

Five Percent of Air Explodes

There is, therefore, a good hope of substituting non-inflammable fuel for gasoline. There still remain two inflammable elements; the hydrogen and the fabric.

The use of helium, of course, removes the dangers of hydrogen. But how dangerous is the hydrogen itself, which seems to inspire an almost superstitious terror in the present day? Setting aside the possibility of attack by hostile aircraft, the danger of primary gas fire is small. It is only when hydrogen becomes mixed with air so that more than four and a half percent of air is present that there is sufficient oxygen at all for the hydrogen to become inflammable. In the modern airship great care is taken to keep the percentage of impurity below this value. It always takes a good sized spark to ignite hydrogen, and it is only hydrogen escaping from the en-

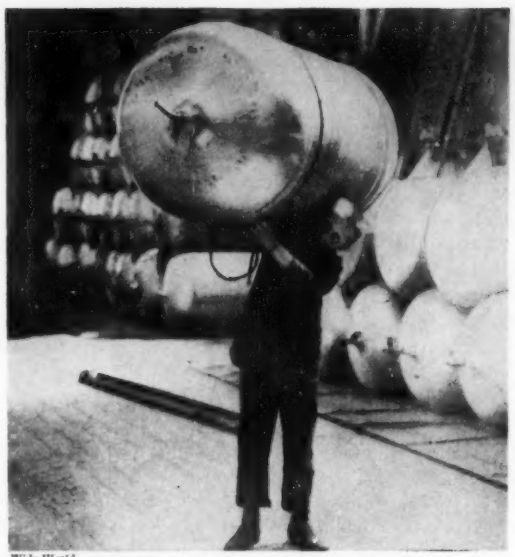
velope that is in real danger of being set on fire. Ventilation in the corridor and the vertical shafts previously mentioned minimize this danger. There is some slight possibility of spontaneous combustion of escaping hydrogen. The results of thorough investigation by German authors show, however, that pure hydrogen passing through a vent cannot be spontaneously ignited. Ignition will only occur if small dust particles are admitted with the hydrogen. The use of filters removes this danger.

With proper precautions it may be said that hydrogen is not likely to be a primary cause of fire. But on the other hand if a fire due to the gasoline system occurs, it will burn away the fabric and the escaping hydrogen will undoubtedly explode. Also in case of structural failure as in the *R-38*, failure entailed the bursting of the gas bags and an explosion.

The case as between hydrogen and helium in regard to fire may, therefore, be summarized as follows: Hydrogen is not likely to be the primary cause of fire. But if the gasoline system ignites or structural failure intervenes, the destruction of the ship will be comparatively slow with helium, instantaneous with hydrogen. While the hydrogen is not likely to be a cause of disaster by itself, helium will insure the slower destruction of the ship and hence the possibility of saving many lives via the parachute.

Helium Not a Final Answer

Since expense is the main drawback to the use of helium, a suggestion has been made often both here and abroad whereby very much less helium could be used and yet its greater safety retained; that is, that the main hydrogen containing bags should be surrounded by an outer system of bags, presumably in the form of a cylindrical shell, containing helium. A much smaller quantity of the expensive helium would then be required. But, while the suggestion seems plausible, it is not certain that it is practical. The weight of fabric employed would evidently be considerably increased. Just as the main gas bags of a dirigible have to have their pressure carefully regulated to correspond with external conditions, so the pressure within this helium shell would have to be regulated, doubling the number of valves and the complexity of the pressure control system. Finally the hydrogen would still have to connect with the outer air with the danger at outlet points in no way minimized. Also in case of primary fire, the hydrogen would still be there to cause an explosion. Before adoption of this idea a very thorough and exhaustive study would have to be made of it.



Wide World

HOW WEIGHT IS SAVED

One of the fuel tanks of the Los Angeles *showing its extreme lightness as compared with its size*

Even when hydrogen is employed, gas losses are a considerable source of expense; with helium it might become prohibitive for anything but military or naval operations. But there is another evident disadvantage in gas loss. It means that reserve buoyancy is being lost; and when there is no more ballast on board, further loss of gas means that the ship must come down. No problem of dirigible piloting is, therefore, more important than keeping gas losses down to a minimum.

One source of gas loss, the pilot cannot minimize and that is diffusion; although this is rather a problem for the constructor than for the pilot. Diffusion, however, is comparatively small for a large airship and has now been reduced to 0.01 percent of the total volume, or less than four percent per annum. This wonderful result has been achieved by lining cotton fabric with goldbeater's skin. Goldbeater's skins are obtained from the "blind gut" of oxen. On a large ship several hundred thousand skins may be necessary. The processing and application of goldbeater's skin is primitive, costly and not entirely satisfactory, since the gas bags remain a most delicate part of the airship, easily cut by the slightest projection and requiring frequent replacement. Yet the use of this skin secures extraordinary gas tightness combined with remarkably light weight.

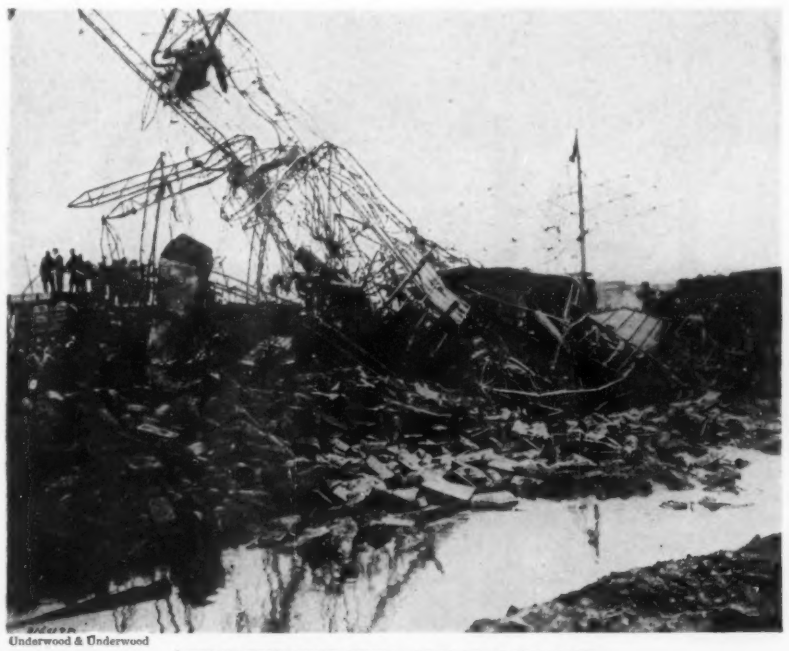
Next, there is a loss due to purging, or purifying the gas at intervals to maintain the percentage of purity. This loss is several times greater than that due to diffusion and in the case of helium it pays to handle the gas extracted from the bags and extract the helium from it. In fact helium purifying plants mounted on railroad cars are already used by the United States Government.

The Sheen of Silver Has Its Use

Again, there is the loss due to temperature variation of the gas inside the bag as compared with the temperature of the outside air. When an airship comes into the path of a hot sun, the sun's rays pass on to earth through the intervening atmosphere scarcely warming it. But when they pass through the rubberized fabric, the light rays are converted into heat and the temperature inside the bags rises. This is exactly what happens inside a green-house or a tent—and everyone knows how uncomfortable a tent in the sun can be. It is to keep out the sun's rays that finely ground aluminum powder is used on the outer covering of the *Shenandoah* giving it that beautiful silvery sheen. When the temperature inside the bags rises, the gas escapes and the airship rises. When later the superheat disappears ballast may have to be thrown out to make up for the lost gas. A skilled pilot, however, may keep these losses down to a minimum by using the dynamic lift present in an airship as in an airplane, though to a smaller degree. Thus, when the sun superheats the gas, the airship is nosed down, the dynamic forces are downwards, the ship sinks far enough to get into a region of higher atmospheric pressure so that gas is not lost. In the flights of the *Shenandoah* it has been found possible to navigate "valving" small quantities of helium or none at all.

Two important methods have been devised to meet this situation. First the recovery of water from the exhaust gases, the weight of this water compensating for the weight of fuel burned up, and secondly the use of the hydrogen from the gas bags as fuel mixed with the gasoline.

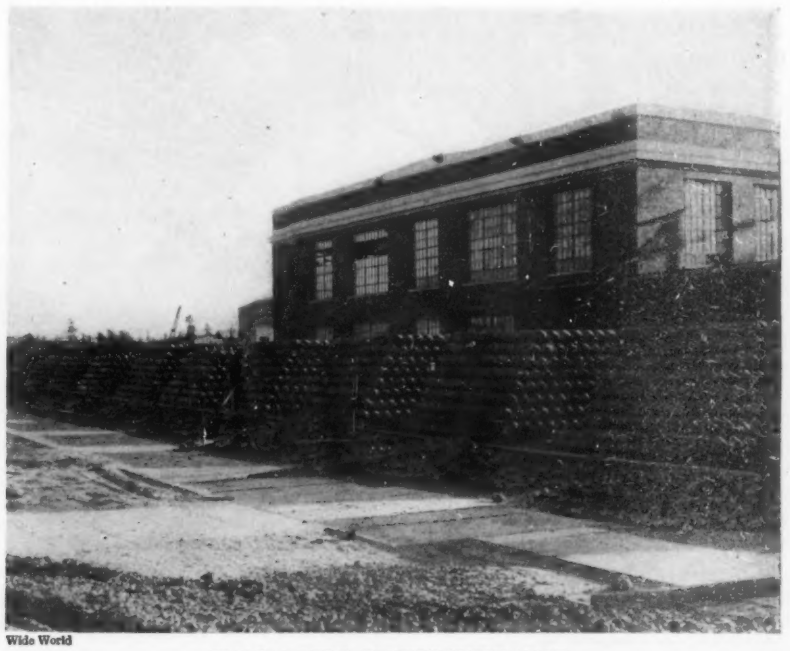
Pure gasoline consists entirely of hydrogen and carbon. When it is burned in an engine, the carbon



Underwood & Underwood

FIRE FINISHED THIS AERIAL COLLAPSE

The wreckage of the Roma *which, due to structural failure, collapsed and burst into flames, causing the death of thirty-three men*



Wide World

HALF A MILE OF FIRE INSURANCE

Twenty carloads of helium gas for the Los Angeles. *The containers are coupled to a single pipe line and the gas is led thus to the gas bags of the ship*

combines with some of the oxygen of the air to form carbon dioxide, so deadly in a small garage, and the hydrogen combines with more oxygen to form water.

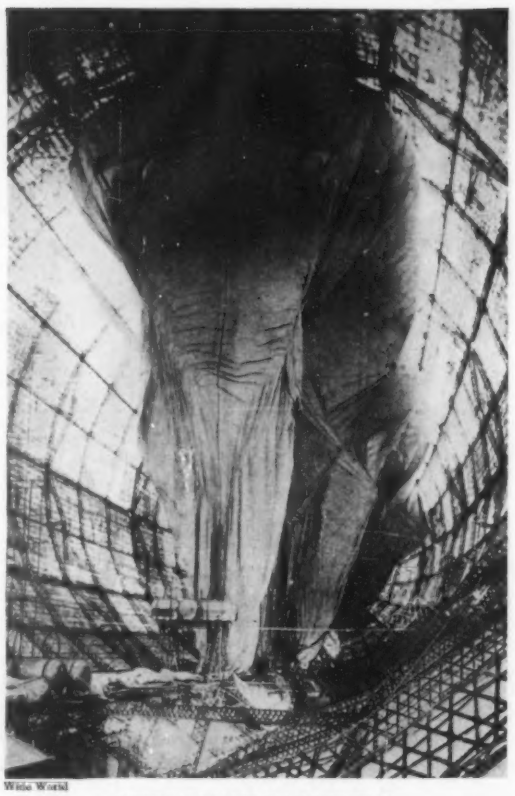
In burning a pound of gasoline about fifteen pounds of air are required and about one and a half pounds of water are formed in the process. The problem is to recover the major part of this water. The exhaust gases are hot and must be cooled to 212 degrees, Fahrenheit, for condensation. So far the process has been tried most successfully on a small army airship. The apparatus occupies a space above the passenger car which is roughly a five-foot cube. It consists of many small streamlined aluminum tubes, exposed to the rush of air, inside which the exhaust gases circulate, cool and gradually give up the water they contain. The water runs into a sump, is pumped back into the water ballast bags and thus balances the loss of weight due to the burning up of the fuel.

Using Hydrogen to Save Fuel

In the second method of compensation the hydrogen which is let out of the gas bags burns in the engines in combination with the gasoline. Experiments carried out by the well-known internal combustion engineer, Ricardo, demonstrated that by mixing hydrogen with the gasoline, the consumption of the latter could be reduced from .55 to .35 pounds per horsepower hour. The effect of this on the operating value of an airship is enormous, since it means that the range is increased fifty percent. Moreover, when hydrogen is used in this way, the cumbersome ballast recovery apparatus is dispensed with. With ballast recovery apparatus also the range is in nowise increased. The ability to burn hydrogen in the engines is therefore a strong point in its favor as compared with helium.

If these various methods of fighting gas losses are efficiently employed, it is quite certain that annual gas expense of even a helium-filled ship will be within reason.

The great military disadvantage of the German Zeppelins was their vulnerability to incendiary projectiles. In the early stages of their attacks on England while the Zeppelins were obliged to navigate at low altitudes, they succumbed again and again to the first shots of a defensive airplane. Undoubtedly the non-combustible gas, helium, would have been of great value in the presence of an



Wide World

LIKE A GIANT PACHYDERM

The illustration shows the enormous inner gas bags of the Los Angeles *after three hours of inflation with hydrogen*

enemy. When it was realized that the United States had a monopoly of this gas, its use was advocated with great enthusiasm by the services and the public alike as likely to give America supremacy in lighter-than-air craft. Of late navy opinion seems to have changed and public utterances of navy officers have frequently contained warnings against undue insistence on the advantages of helium.

The chemical inertness of the gas which makes it non-inflammable, renders its separation from the natural gas a difficult matter. The only method of attack is a freezing and liquefying process. Every constituent of the gas is frozen, with helium whose freezing point is so much lower left in gaseous form. But a helium reduction plant may have to cope with a natural gas whose helium content is only one-tenth of one percent by volume. No wonder the process is expensive and must remain so.

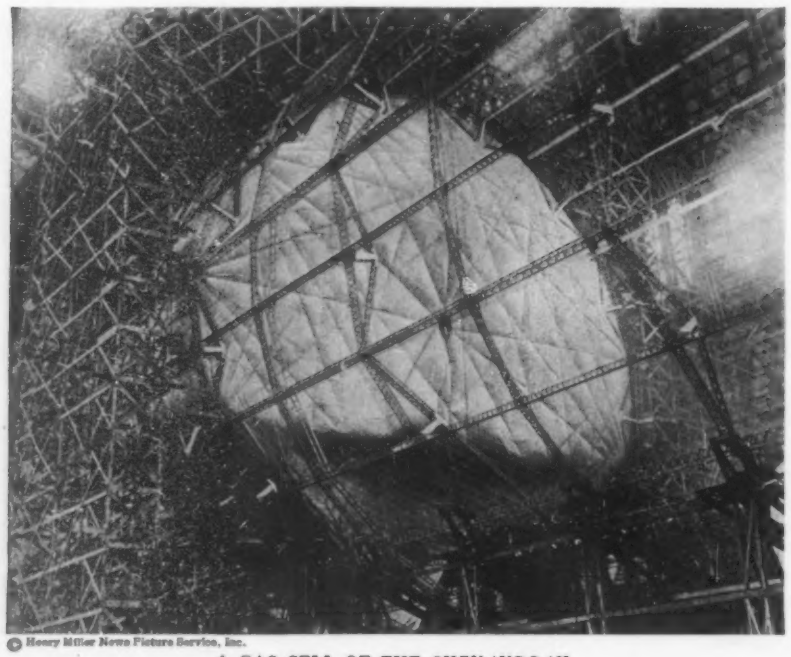
By the use of certain elaborate plants hydrogen may now be manufactured at $2 to $3 a 1,000 cubic feet. Before the war helium cost $1,700 per 1,000 cubic feet made in the laboratory, just before the armistice it was costing $146, and now it costs about $40 per 1,000 cubic feet. True, the sluggish helium diffuses more slowly, does not react so quickly to changes in temperature, and being non-inflammable, allows the use of a temperature compensation device which can be made to prevent loss of gas and ballast. Also, on account of its non-inflammability it can be recovered in its original purity by "purging," returned to the gas bags even in better condition than before and thus conserved. But its cost will, in spite of these factors, always remain ten or fifteen times that of hydrogen.

What the Lifting Power Must Do

But a much stronger argument against the use of helium is its reduced lifting capacity. Although helium is about twice as heavy as hydrogen this does not mean that its lift is only half as great. At normal pressure and temperature 1,000 cubic feet of air weigh seventy-five pounds, while 1,000 feet of hydrogen weigh only five pounds, giving an effective lift of seventy pounds.

With helium weighing about nine and one-half pounds under the same conditions, its lift is only sixty-five and one-half pounds. In practice it is found that a helium-filled airship has only ninety-two percent of the lift of a hydrogen-filled airship of the same volume. But this apparently small difference may have a tremendous importance on the endurance and range. The lift of the gas bags has to carry the structure of the ship, the weight of the envelope and inner gas bags, the gondolas, control surfaces, the power plant, a multitude of miscellaneous equipment, water or sand ballast and crew. It is only the remainder which is available for carrying fuel. If lift available with a hydrogen ship for carrying fuel is some fifteen or twenty percent of gross lift, the difference of eight percent when helium is used means that the fuel capacity is cut in half.

Time and experience alone will show whether the undoubted though not overwhelming advantage of helium from the point of view of fire hazard will outweigh these disadvantages.



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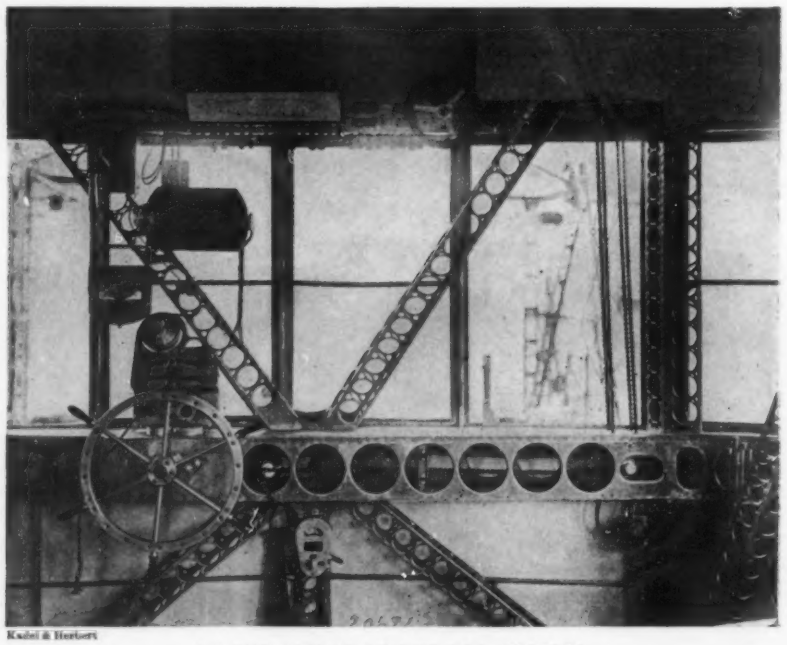
A GAS CELL OF THE *SHENANDOAH*

The huge dirigible contains many such individual gas cells. Each is protected by its framework of metal girders



Kadel & Herbert

ON THE BRIDGE OF THE *LOS ANGELES*

Inside the control gondola are the instruments by which the pilot follows and directs the behavior of the ship

New Facts About Life on Mars

By Henry Norris Russell, Ph.D.

THE time is ripe to speak of some very interesting work that has been done during the recent opposition of Mars, and is now published. The great western observatories were well prepared for the favorable situation of the planet last summer, and extensive series of observations were made.

Drawings, based on direct visual observations, and photographs on fine-grained plates, were made by Slipher at the Lowell Observatory and by Trumpler at the Lick Observatory. Both observers agree with one another and with the work of previous years in finding numerous nearly linear dark markings or "canals" crossing the brighter and redder portions of the surface of the planet, in seeing an abundance of detail within the large darker areas, and in the conclusion that the photographs, although they cannot be made fine-grained enough to reveal the more delicate detail which is directly visible, afford conclusive and impersonal evidence of the reality of the stronger canals, as well as of the more conspicuous features.

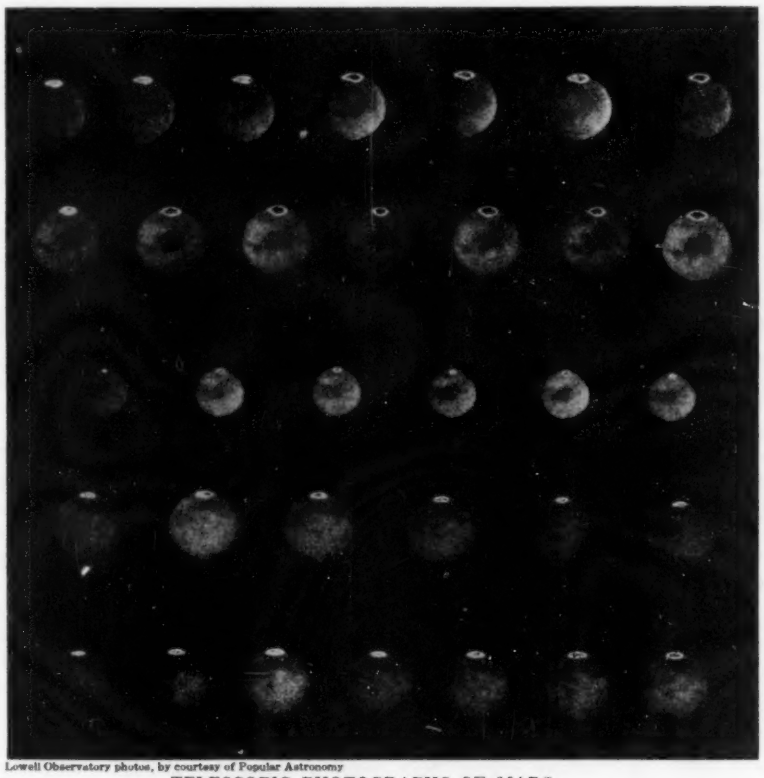
A series of Dr. Slipher's photographs (printed in the Publications of the Astronomical Society of the Pacific) show in a very beautiful and convincing way how the dark regions grow larger and deeper in hue as the polar caps wane and the Martian spring advances. While on one of the photographs, the dark markings on the opposite hemispheres, where autumn is changing to winter, are seen to fade.

Further information is secured by photographing the planet through screens of different colors—using, of course, a reflecting telescope, which is perfectly achromatic, and special photographic plates. The images obtained with violet light show the polar caps very strongly but only traces of the other markings. With deep red light the dark markings show great contrast and the polar cap is hardly brighter than some other regions. Photographs taken with intermediate colors show a gradation between these extremes.

Dr. Wright, of the Lick Observatory, gives a reasonable explanation of these differences, as due to the presence of a fairly dense atmosphere around the planet. Any atmosphere, whether on earth or on Mars, must scatter sunlight and shine as our blue sky does. If the atmosphere is foggy or hazy it will scatter all colors almost alike, but if it is clear or nearly so it scatters the short waves very much the most strongly, producing the familiar blue haze. For this reason a photograph of a landscape taken on an ordinary plate with violet light may fail to show a distant mountain, while one taken through a screen of yellow or red reveals it.

Dr. Wright prints on the same page, photographs of Mars taken with violet light and deep red light and photographs of the Santa Clara Valley in California, as seen from the mountain where the Observatory stands. On the first photograph the valley is entirely lost in the haze; on the second, every detail stands out sharply. The comparison of the Martian and terrestrial pictures, is really all the evidence that any one should require for attributing a great part, at least, of the effect observed on Mars to the atmosphere of the planet.

Dr. Wright concludes, also, that it is probable that clouds or haze hang over the polar cap and that these account for at least a part of its brightness when photographed with violet light. He also advances, with due discretion, the opinion that the planet's atmosphere may be as much as a hundred miles in depth. This suggestion is based on the fact that the image of the planet, photographed with the violet rays, appears larger than does the image photographed with red rays. Further tests are necessary to determine how much of the observed effect may arise from the spreading of the photographic image on the plates. In the present writer's judgment, it is probable that the actual height of the atmosphere may turn out to be less but this does not detract one whit from the value or importance of Dr. Wright's work.



Lowell Observatory photos, by courtesy of Popular Astronomy

TELESCOPIC PHOTOGRAPHS OF MARS

The white spot is the polar cap, possibly of ice or snow

Most interesting of all—because bearing most directly upon the vexed question of the temperature of Mars, are the measurements of the heat received from the planet. Such observations have been made at the Lowell Observatory, by Coblentz and Lampland and also at Mt. Wilson, by Pettit and Nicholson, both pairs of observers using the exceedingly delicate vacuum thermocouples which were described in these columns a year or two ago. The heat-receiving surface is so small that it is possible to set it at will upon different parts of the planet's surface.

Moreover, the heat may not only be measured, but analyzed. By the use of screens of various materials—water, glass, fluorite, rock-salt—it is possible to cut off more or less of the invisible long-wave radiations and to find out what proportion of it is transmitted by one of these screens and is stopped by the one preceding on the list.

In this way the heat which is merely reflected by the planet and which is almost all in the short wavelengths can be distinguished from the heat which is given out by the planet's own warm surface. Knowing the amount of this latter heat, and the size and distance of the planet, the temperature of the radiating surface can be calculated. A second and nearly independent determination of the temperature can be made by comparing the relative proportions of this planetary radiation which are transmitted by the various screens. Allowances for the absorption of radiation in the earth's atmosphere is necessary, and has been carefully made.

The results obtained at the two observatories are in excellent agreement. For the center of the planet's disk—a region in the Martian tropics under a vertical sun—the temperature is found at Mt. Wilson to be 7 degrees, Centigrade, or 45 degrees, Fahrenheit, while the values obtained at Flagstaff range from 7 degrees to 18 degrees, Centigrade, or 45 degrees to 65 degrees, Fahrenheit.

Near the planet's limb, where the sun is rising or setting, the temperature comes out – 13 degrees, Centigrade, or 9 degrees, Fahrenheit, from the Mt. Wilson observations, while the region of the polar cap gives about – 70 degrees, Centigrade, or 90 degrees below zero, Fahrenheit.

These temperatures are calculated on the assumption that the planet's surface is a good radiator, which is probably not far from the truth for the surface in general. The white polar caps are probably poor radiators, in which case their actual temperatures must be higher than the low value here given.

The outcome of these measures is apparently quite definite and we may regard it as very probable that the temperature on Mars' surface runs well above freezing at midday near the equator.

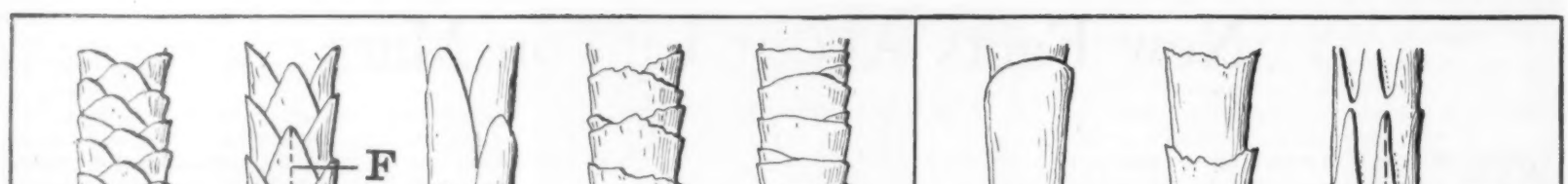
This makes it quite possible that vegetation may exist upon the planet, and Dr. Slipher says, with reason, that the seasonal changes in the dark markings all obey the law of change that we should expect of vegetation.

On the other hand, the very low polar summer temperature found at Mt. Wilson looks unfavorable to the belief that the polar caps are composed of snow (on which all else depends). However, for reasons already stated, the temperature of this region cannot be regarded as finally settled.

Whether vegetation actually *does* cover much of the planet's surface is harder to determine. If the chlorophyll of the leaves of Martian vegetation is similar to that of terrestrial plants, it should reflect deep-red light strongly and the dark markings should show bright when photographed through a suitable screen. Nothing of this sort has been observed but the failure of the test is not conclusive, for many terrestrial plants do not show this peculiarity.

The one crucial test appears to be the presence or absence of free oxygen in the atmosphere of Mars. By means of the ingenuous method invented independently by Lowell, Campbell and St. John, the spectrum lines due to absorption in the planet's atmosphere can be got clear of those originating in our own.

Observations on Mars may be under way even now. When their results are announced, we will have the best evidence that seems at present to be attainable. If oxygen is there, the presence of vegetation will be decidedly probable.



THESE EIGHT TYPES OF SCALES ARE FOUND IN HAIRS OF MAMMALS

These drawings represent all the varieties of the scales which make up the surface layer of mammal hairs. There are many modifications of these simple types. F indicates where the measurements are taken to secure the scale index, which is the relation between scale length and the diameter of the hair

Revolutionary New Facts About Hair

Recent Comparative Studies of Animal Hairs Under the Microscope Reveal a Remarkable Relationship Hitherto Unsuspected

By Leon Augustus Hausman, Ph.D.

EARLY microscopists assumed, and the preliminary studies of later investigators tended to support the idea, that each species of animal bears a kind of hair peculiar to itself. Whenever several different samples of hair, from as many different animal species, were examined it was found that they differed in structure so appreciably that it was possible to assign each to its source. This supposed fact has since been made use of by "scientific detectives" and in many other ways.

During an examination of a series of ape and monkey hairs a year or so ago, the writer began to doubt whether this relationship between the character of the hair and the species of mammal was really so definite as had been supposed. The question then arose: Are individual hairs like the leaves of trees; that is, is each referable to a single unvarying source? Or to put it another way: Does each species of mammal produce a kind of hair structurally peculiar to itself, and to itself alone?

The Pith and Pigment of a Hair

The question could be answered only by examining a large number of mammal hairs, from mammals representing all the existing great groups, and by tabulating the results of the microscopic examination of these hairs. What are the elemental structures of a hair shaft-structure which are present in all hairs and between which comparisons can be made?

These elemental structures are four in number. First is the *medulla*, or pith of the hair, a central column composed of variously shaped and disposed cells or chambers, most commonly piled one above another like a pile of pennies. Second is the *cortex*, a clear, usually transparent substance surrounding the medulla and made up of elongated cells sometimes referred to as hair spindles. Third is the *pigment granules*, to which the color of the hair is primarily due, scattered about among and within the hair spindles and the medullary cells. Fourth is the *cuticle*, which is the outermost layer or "skin" of the hair shaft and which is made up of thin scales overlapping on each other like the scales of a fish or like the shingles on a roof. These thin, transparent, delicate scales on the outside of the hair are known as the cuticular scales, and present a multitude of beautiful forms. The writer has elsewhere described and classified these cuticular scales as falling into eight form-groups. The figure illustrates the type forms of these eight classes. The classes called "imbricate" scales include the separate scales, like the shingles on a roof, and comprise five varieties; while the coronal scales, so called from their resemblance to crowns, present three varieties.

New Facts for Sherlock Holmes

Many crimes have been detected by the microscope. In the soberest of law courts, no less than in those fabled rooms on Baker Street, such trifles as a drop of blood, a speck of dust, the thin and twisted fiber of a hair, have turned the tide of life or liberty for some poor wretch who stood accused before a jury of his peers.

Scientists have sworn, for example, that this or that strand of hair was identifiable under their lenses as human or not human; was traceable to a definite animal, a dog, a cow, a bat, some curious creature of the zoo.

It is very likely that some of these scientists were wrong. Dr. Hausman shows in this article how the same animal body may carry quite different types of hair.

Sherlock Holmes must write a new page for his famous notes.

The medullas or piths of hairs vary also in structure, as is shown in another figure. Sometimes the medullary cells are separate, as in the discontinuous type, marked number 2. Sometimes the cells are coalesced, as in the intermediate and continuous types, numbers 3 and 4. Many hairs lack the medulla element altogether. In other hairs the medulla element is represented only by fragments.

In the discussion of the scale and medulla characters of hairs which follows, the status of these structures is considered midway between the base and tip of the hair. The hairs used for comparison were the under, or fur hairs of the specimens, taken from the region of the middle of the back.

Doubt of the relationship between hair structure and the species of animal was first suggested to the writer, as has been said, during the examination of a series of ape and monkey hairs. These hair samples had been selected at random from sixteen species of primates, representing the existing nine families of these animals.

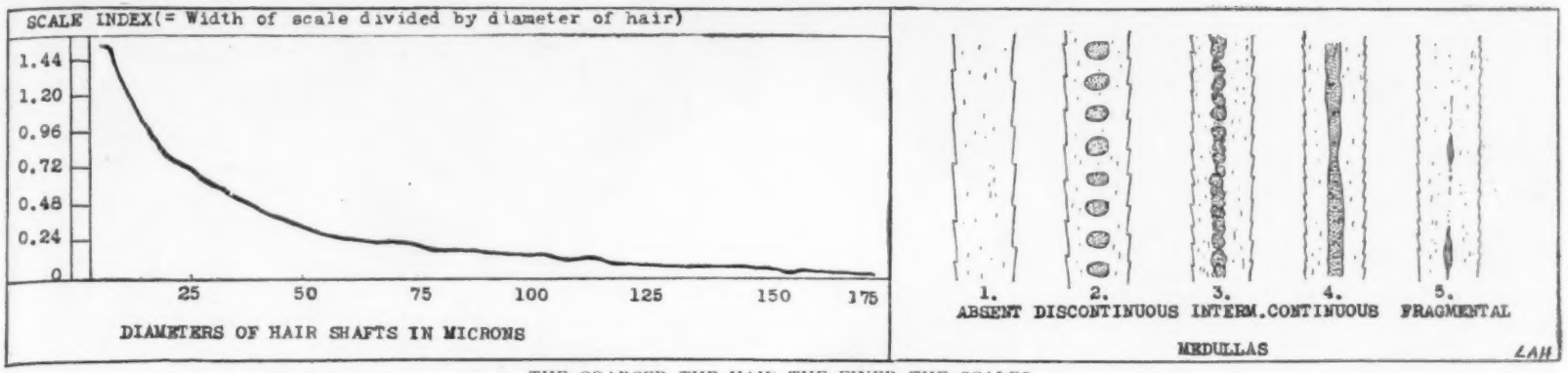
Scales That Grow on Hair

In these hairs it was noted that an increase in the diameter of the hair shaft was accompanied by a decrease in the width (or length) of the exposed surface of the cuticular scales. This distance is known technically as the proximo-distal diameter of the scale. A quantitative expression of the relation between this proximo-distal diameter of the scale and the hair shaft on which the scales occurred was devised, and termed the *scale-index*. Where D is the diameter of the hair shaft, F the proximo-distal diameter of the scale, and S the scale index; the relation is given by the formula:

$$\frac{F}{D} = S.$$

Computations of these scale indices, "S," for the sixteen samples of primate hairs, and the plotting of these indices against the diameters of the hairs showed that as the hair diameters became greater the scale index became smaller. Or, what is the same thing, as the hairs became coarser the scales became relatively finer.

A comparison of the medulla forms with the diameters of the hairs brought out the additional fact that the finer hairs possessed the discontinuous types of medullas while the coarser hairs showed the intermediate and continuous types.



THE COARSER THE HAIR THE FINER THE SCALES

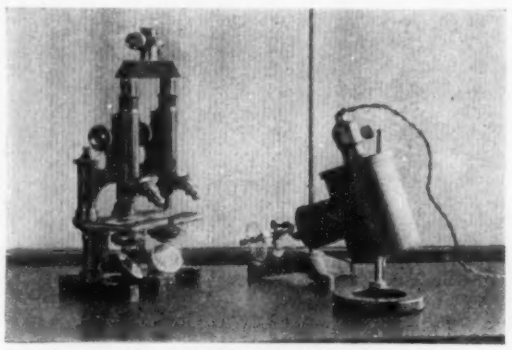
The curve on the left records the results of microscopic examination of 190 specimens of hair from as many different species of animals. As the hair shaft becomes coarser, the scales become relatively finer. The various kinds of piths found in hairs are shown on the right

These observations suggested that perhaps the size and form of cuticular scales was related, not to species of animal, but merely to the diameters of the hair shafts, a notion wholly new and quite at variance to existing belief. Accordingly a series of 190 samples of hair, from as many different species of mammals, was prepared. It represented all the existing orders of mammals except the *Cetacea* (whales, porpoises, etc.). The shaft diameters of these hairs were measured and averaged; the scale indices were computed and the medulla forms classified. The results are given graphically in the curve on page 99.

The Finest Hairs from Bats

Since 190 hairs were examined, taken at random from all the existing orders of mammals except the whales, and since a study of scale-size and scale-form showed a definite relationship between these two characters, we may conclude that the forms of the cuticular scales of hairs bears a relationship, not to species of animal, as was formerly supposed, but to diameter of hair shaft. That is to say, the coarser the hair the finer the scale. Fine hairs bear one type of scale, medium hairs another, and coarse hairs still another. As there are all gradations in coarseness and fineness of hairs, so are there all gradations in type of scales.

An examination of the medullas of the same hairs which were examined for their scale structure revealed the fact that the form of the medulla, like that of the scale, bore relation, not to the species of animal but to the diameter of the hair shaft. The finest hairs, which are, in general, those of the bats bear no medullas. The medium-sized hairs show usually the discontinuous or intermediate types. The coarse hairs exhibit the continuous type of medulla. In stiff, bristle-like hairs only fragments of medullary cells are found.



HOW HAIRS ARE COMPARED

Two microscopes fitted with a single eyepiece show two samples of hair in the same field of vision

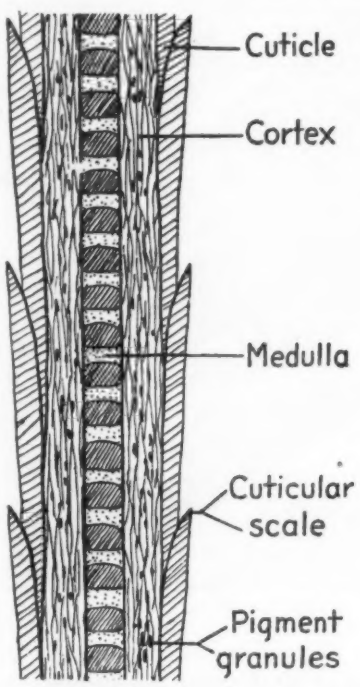
The pigment granules, apparently bear no relationship to the diameter of the hair shaft nor do the cells of the cortex, except, of course, that there are a larger number of these cells in the thicker hairs.

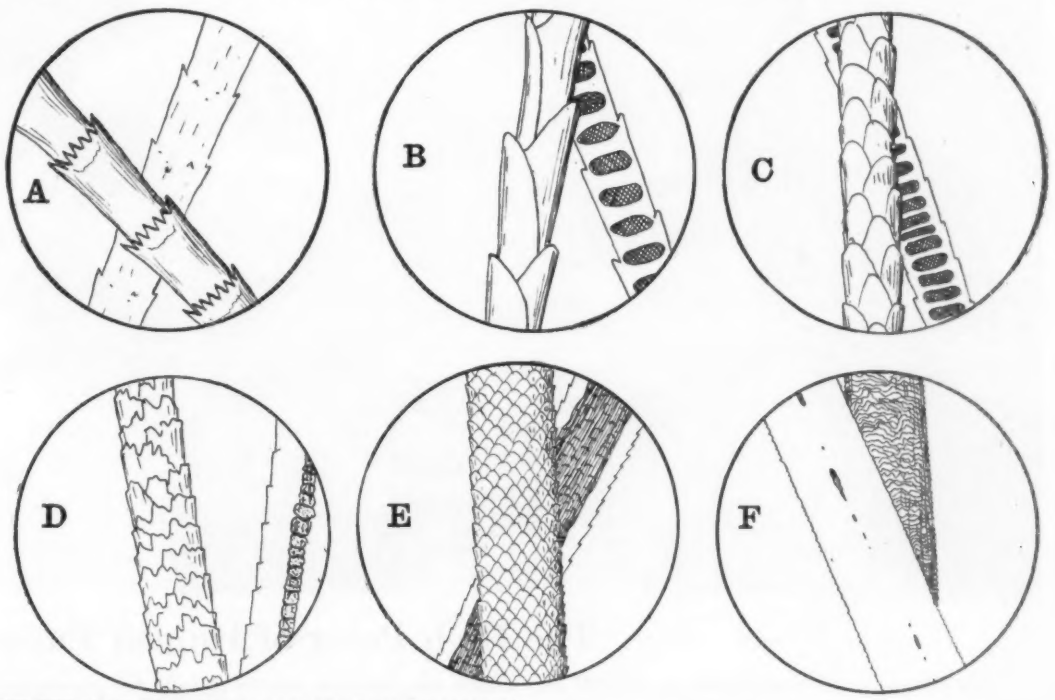
It is apparent, therefore, that the facts upon which microscopists have been accustomed to depend for the determination of a hair, namely, the scale character and the pith or medullary character, are determined by the size of the hair rather than by the species of animal.

Does this mean that an unknown sample of hair, as, for example, a hair from some commercial fur, cannot be referred to its source by microscopic examination? Not at all. Sufficient individual differences still exist to make it possible, in the majority of cases, for the microscopist to determine the specific origin of samples of hair. But this requires a more or less complete examination of the unknown hair and a comparison of it with hairs of known origin.

Types from the Duck-billed Platypus

For such determinations the *comparison ocular* fitted to two microscopes as shown in the figure, is brought into use. The images of the two hairs or other objects which it is desired to compare, both equally magnified and subject to the same light intensity, can be brought close together into the same field of view. Another interesting feature of this relationship between hair structure and hair size is that some animals may bear upon the body hairs of several different types. This is true, for example, of the Duck-billed Platypus of Australia and of the Spiny Anteater.





HOW THE EYE OF THE MICROSCOPIST SEES A HAIR

At the left is a cross-section of a hair, showing its various parts. The hair of a bat is shown at A and that of a golden mole at B. At C is the hair of a tree shrew, at D is that of a Madagascar ground-hog, and at E is a specimen from the American prong-horned antilope. F is the hair of a hippopotamus. The hairs are not drawn to size, the hippopotamus hair being over twenty times as thick, in reality, as the bat hair

The "Times" World copyright photograph

The High Point of Human Endurance

This photograph was taken at 28,000 feet above sea level, a record height for photography. The summit of Mt. Everest, the highest mountain on earth, is seen a few hundred yards distant. The figure in the foreground is that of Colonel Norton, member of the Mt. Everest Expedition. This was the highest point reached by that expedition. Colonel Norton had used a full hour in climbing only eighty feet above his former position

Which Radio Set to Buy

The Second Month of Our New Service to Radio Purchasers

THIS Department was inaugurated last month as an aid to readers who contemplate buying a ready-for-use radio receiver. Many such readers ask us what radio set is "best." A real answer is neither easy nor simple. This Department is our attempt at it.

The plain truth about it is that there is no "best" radio set, any more than there is a "best" suit of clothes or a "best" wife. It all depends on who wants it. One man will want only to hear the broadcasting from local stations and he will not mind wearing the two telephones and the band over his head. The next man will demand to bring in every broadcasting station in the country on a loudspeaker every night in the year.

The first man's demands are modest. He can get what he wants with almost any of the low-priced receivers. The second man is not going to get what he wants at all. No radio receiver yet devised will bring in every distant station on any night when you want to hear them.

To decide about buying a radio receiver you have to decide, first of all, just what you want. Are you anxious for distance or content with local stations? Do you demand a loudspeaker or not? Can you erect an outdoor antenna over a hundred feet long or must you be satisfied with a short one or with an indoor loop? How much money will you spend?

The following table lists most of the ready-for-use radio receivers now on the market. Decide about your requirements, go through this list, pick out the one you want. Better still, pick out three or four that you like, then go to a dealer and look them over.

All the receivers listed are worth what you pay for them and will give you good service, each within its limitations. The price you must pay for a complete outfit will be, of course, the price of the receiver itself (as listed), plus the cost of the equipment listed under accessories.

Important!

If you buy a receiver, using this table as your guide, and find the results unsatisfactory please write and tell us exactly what proved to be wrong. Address The Editor, Scientific American, 233 Broadway, New York, N. Y.

It is impossible to state the exact cost of these accessories. This depends on you. There is a wide latitude in price. Loudspeakers, for example, can be had from eight or ten dollars up to a hundred.

As to batteries, the dry-battery outfits cost less in the beginning, but for sets having three tubes or more the upkeep is less with storage batteries. Also, the storage battery (used for the filament or "A" battery) will give you greater volume, tube for tube, and more dependable operation. Dry batteries, on the other hand, are more convenient and portable.

An outdoor antenna, properly erected, will give you greater distance than a loop. Or, what is the same thing, you can pay less for your set and get the same results. But a loop set, although more expensive, will usually give you clearer reception and greater ease of separating the broadcast stations from one another—what the radio fan calls "selectivity." Location has much to do with this. Some places are good for radio, others are bad. In general, the country is better for reception than the city.

The distance obtainable with a radio receiver depends on many things. Locality is a main one. Another is the weather. Still another is the skill of the person who does the tuning. The hearing of distant stations with a given type of set *cannot* be guaranteed.

If some receiver in which you are especially interested is missing from this table that does not mean necessarily that the receiver has failed to pass our inspection. Several new receivers have been added to this month's list. Others are awaiting test. If they pass our inspection they will be listed next month.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
CROSLEY 50	CROSLEY RADIO CORPORATION	$14.50	One tube, "A" and "B" batteries, antenna equipment and phones. Cost from $18.00 to $30.00.	Single circuit regenerative	Outdoor	This is a simple one-tube outfit built to sell at as low a price as possible consistent with good results. Will bring in stations up to 500 miles away with headphones.
CROSLEY 50 P	CROSLEY RADIO CORPORATION	$18.00	One tube, "A" and "B" batteries, phones and length of flexible wire. Cost approx. $17.00.	Same as Crosley 50	Outdoor	This is the Crosley 50 made up in portable form. Should be used with dry battery tubes to keep down the weight.
CROSLEY 51	CROSLEY RADIO CORPORATION	$18.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	Same as Crosley 50 plus one stage amplifier	Outdoor	Same as the Crosley 50 with one stage of audio amplification which gives greater volume of sound.
"SHEPCO" All Purpose	THERMIODYNE RADIO CORP.	$21.00	One tube, "A" and "B" batteries, antenna equipment and phones. Cost $18.00 to $30.00.	Experimental	Outdoor	A receiver for the man who wishes to experiment with various circuits. The leads from the various parts are brought up to a binding post panel so that many circuits may be tried by connecting the posts in different ways.
CROSLEY 51 P	CROSLEY RADIO CORPORATION	$25.00	Two tubes, "A" and "B" batteries, phones and wire for antenna. Cost $20.00 to $32.00.	Same as Crosley 51	Outdoor	Same as the Crosley 51 but fitted into a portable case.
PARAGON TWO	ADAMS MORGAN CO., INC.	$27.50	Two tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $23.00 to $45.00	Regenerative	Outdoor	Gives loudspeaker results on local stations and brings in distant stations on headphones. Single dial tuning.
MODEL R	FARAWAY RADIO CO.	$29.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	One stage radio-frequency and detector	Outdoor	Designed to bring in distant stations with headphones. Two tuning controls. Metal panel finished in gold or platinum color.
CROSLEY 52	CROSLEY RADIO CORPORATION	$30.00	Three tubes, "A" and "B" batteries, loudspeaker, phones and antenna equipment. Cost $40.00 to $60.00.	Same as Crosley 50	Outdoor	Essentially the same as Crosley 50 with two stages of audio amplification added to give loudspeaker operation on nearby and semi-distant stations. Two controls for tuning.
TYPE 224	C. D. TUSKA CO.	$35.00	One tube, "A" and "B" batteries, phones and antenna equipment. Cost $18.00 to $30.00.	Regenerative	Outdoor	A high-grade, single-tube receiver for those who wish to get maximum distance and selectivity with one tube. Tunes sharply with two controls.
RADIOLA III	RADIO CORP. OF AMERICA	$35.00 Includes two tubes and headphones.	"A," "B" and "C" batteries and antenna equipment. Cost $10.00 to $15.00.	Regenerative	Outdoor	Gives excellent selectivity and is sensitive. Uses dry-cell tubes only and will operate a loudspeaker on nearby, powerful stations.
MRC-2	MICHIGAN RADIO CORP.	$37.50	Two tubes, "A" and "B" batteries, phones and antenna equipment. Cost $23.00 to $35.00.	Regenerative	Outdoor	Is fitted with levers instead of the usual dials for tuning. Good for headphone reception up to 500 miles or more under favorable conditions. Three controls.
PARAGON THREE	ADAMS MORGAN CO., INC.	$48.50	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $30.00 to $50.00.	Regenerative	Outdoor	Gives loudspeaker results on semi-distant stations when conditions are favorable. Single dial tuning.
MODEL F	FARAWAY RADIO CO.	$59.50	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	One stage transformer coupled radio-frequency.	Outdoor or indoor	Simple to tune and brings in distant stations on loudspeaker under favorable conditions. Metal panel finished in gold or platinum color.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
FRESHMAN MASTERPIECE	CHAS. FRESHMAN CO.	$60.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00	Tuned radio	Outdoor	Brings in local stations on loudspeaker with good tone.
MRC-12	MICHIGAN RADIO CORP.	$62.50	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Regenerative	Outdoor	Three levers instead of the usual dials are used to control this receiver. Sensitive and selective. Will bring in moderately distant stations on a loudspeaker.
RADIOLA III-A	RADIO CORP. OF AMERICA	$65.00 Includes four tubes and headphones.	"A," "B" and "C" batteries, loudspeaker and antenna equipment. Cost $25.00 to $50.00.	Regenerative	Outdoor or indoor	Uses 1½-volt tubes, which can be operated by dry batteries, or 2-volt storage battery. Sensitive and selective. Brings in distant stations on loudspeaker under favorable conditions. Two tuning controls.
TRIRDYN	CROSLEY RADIO CORPORATION	$65.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Radio-frequency plus reflex	Outdoor or indoor	Gives marked selectivity and is sensitive to distant signals. Two tuning controls which may be logged for each station.
TYPE T	WARE RADIO CORPORATION	$65.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $35.00 to $50.00.	Neutrodyne reflex	Outdoor	Attains maximum results with three 199 type tubes. Sensitive and selective with simple tuning by two dials. Will operate loudspeaker on distant stations under favorable conditions.
MODEL 9	ATWATER-KENT MFG. CO.	$65.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Sensitive and selective with two controls. Open set with apparatus mounted on a board, no panel. Brings in distant stations when conditions are right.
PARAGON FOUR	ADAMS MORGAN CO., INC.	$65.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker with good volume when conditions are favorable.
CLEAR-O-DYNE MODEL 70	CLEARTONE RADIO CO.	$75.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Gives loudspeaker volume on distant stations when conditions are favorable.
FADA "Neutro-Junior"	F. A. D. ANDREA, INC.	$75.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $55.00 to $80.00.	Neutrodyne reflex	Outdoor	Sensitive and selective. Tuned by two dials. Loudspeaker volume on distant stations under favorable conditions.
TONE-A-DYNE	RESAS, INC.	$78.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Brings in distant stations with loudspeaker volume when conditions are favorable.
MODEL V	COLIN B. KENNEDY CORP.	$75.00	Three tubes, "A" and "B" batteries, antenna equipment. Cost $55.00 to $80.00.	Regenerative	Outdoor	Designed for home use to receive local and high-powered distant stations on loudspeaker. Uses either dry battery or storage battery tubes.
RADIODYNE WC-5-B	WESTERN COIL & ELECTRICAL CO.	$80.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Brings in distant stations on loudspeaker with simple tuning control. Sensitive and selective.
TYPE 301	C. D. TUSKA CO.	$85.00	Three tubes, "A" and "B" batteries, headphones and loudspeaker, antenna equipment. Cost $55.00 to $80.00.	Radio-frequency reflex	Outdoor	Will bring in distant stations and is highly selective. Two main tuning controls.
BRANDOLA 3	J. F. BRANDEIS CORPORATION	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Brings in local stations with good volume and distant stations when conditions are favorable.
AMRAD NEUTRODYNE	AMERICAN RADIO & RESEARCH CORP.	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker. A feature of this receiver is two-dial tuning.
MODEL 10	ATWATER-KENT MFG. CO.	$85.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Open set with apparatus mounted on a board, no panel. Sensitive and selective, with three controls. Brings in distant stations on loudspeaker under favorable conditions.
MODEL 19	ATWATER-KENT MFG. CO.	$85.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor	Electrically the same as Atwater-Kent Model 9 except that it is fitted in cabinet.
DAY-FAN OEM-11	DAYTON FAN & MOTOR CO.	$90.00	Three tubes, "A" and "B" batteries, loudspeaker and antenna equipment.	Radio-frequency reflex	Outdoor or indoor	A combination of radio-frequency and reflex circuits. Gives loudspeaker results. Easy to tune.
MODEL MW	MIDWEST RADIO CO.	$95.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Simple tuning and brings in distant stations on loudspeaker under favorable conditions.
ZENITH 4 R	ZENITH RADIO CORP.	$95.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Highly sensitive and selective, brings in distant stations on loudspeaker under favorable conditions. Three controls for tuning. Can be used with dry battery or storage battery tubes.
DAY-FAN OEM-7	DAYTON FAN & MOTOR CO.	$98.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Radio-frequency reflex	Outdoor or indoor	Clear tone, selective and sensitive. Tunes easily. Economical in current consumption.
EDISONDYNE	EDISON RADIO CORP.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Tunes easily with three dials which may be logged for each station. Separate rheostats for each tube except two audio tubes which are on same rheostat.
ELECTROLA	AMERICAN SPECIALTY CO.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Very low "B" battery current consumption. Cushion sockets to eliminate microphonic noises. Sensitive and selective.

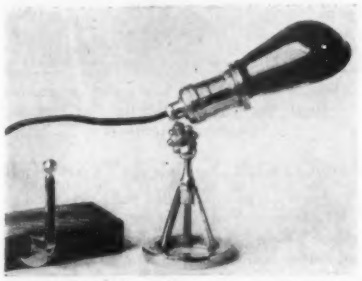
TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
MODEL 20	ATWATER-KENT MFG. CO.	$100.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	This receiver is the same as Model 10 except that it is mounted in a cabinet.
MODEL N R-12	FREED-EISEMANN RADIO CORP.	$100.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Neutrodyne	Outdoor	Selective and sensitive. Will give loud signals on local stations and brings in distant stations when conditions are right.
MURDOCK NEUTRODYNE	WM. J. MURDOCK CO.	$100.00 Includes loudspeaker	Five tubes, "A" and "B" batteries, antenna equipment. Cost $45.00 to $60.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective, will bring in distant stations on loudspeaker under favorable conditions.
MODEL III	COLIN B. KENNEDY CORP.	$101.50 Includes headphones	Three tubes, "A" and "B" batteries, flexible wire for antenna. Cost approx. $25.00.	Regenerative	Outdoor	This is the Model V Kennedy receiver constructed for portability in an imitation leather case with cover containing a compartment for headphones and coiled antenna wire.
MODEL VI	COLIN B. KENNEDY CORP.	$105.00	Four tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Selective and sensitive, gives great volume on loudspeaker on local and semi-distant stations.
MODEL 12	ATWATER-KENT MFG. CO.	$105.00	Six tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	This receiver has the same characteristics as Model 10 with an extra tube added to give great volume on local and distant signals. Three controls, sensitive and selective.
MA 18	MU-RAD LABORATORIES, INC.	$110.00	Five tubes, "A" and "B" batteries, loudspeaker, antenna equipment. Cost $65.00 to $85.00.	Transformer coupled radio-frequency	Outdoor or indoor	Selective and sensitive, low current consumption both "A" and "B" batteries. Gives loudspeaker results on local and distant stations under favorable conditions. One tuning control.
TYPE XL-5	A. C. ELECTRICAL MFG. CO.	$115.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Three controls. Brings in distant stations on loudspeaker under favorable conditions.
TYPE No. 110	FEDERAL TEL. MFG. CORP.	$117.00 Includes headphones and three tubes	"A" and "B" batteries, antenna equipment and loudspeaker. Cost $20.00 to $50.00.	Transformer coupled radio-frequency	Outdoor or indoor	One major control for wavelengths. Selectivity can be varied to suit local conditions. Sensitive on distant signals.
FADA "One-Sixty"	F. A. D. ANDREA & CO.	$120.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Neutrodyne reflex	Outdoor or indoor	Three controls for tuning. Sensitive and selective, brings in distant stations on loudspeaker under favorable conditions.
SUPER CLEAR-O-DYNE MODEL 80	CLEARTONE RADIO CO.	$120.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive. Brings in distant stations on loudspeaker when conditions are favorable.
T R F MAGNAVOX	MAGNAVOX CO.	$125.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Simple to operate as the special type of variometers used for tuning are geared to one control on the panel. Highly selective and sensitive.
BRANDOLA	J. F. BRANDEIS CORP.	$125.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	One dial control for tuning and resistance coupled amplification at audio-frequencies result in simple operation and quality of reproduction.
TYPE 6-D	EISEMANN MAGNETO CORP.	$125.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Three tuning controls. Sensitive and selective. Brings in distant stations on loudspeaker when conditions are favorable.
GRANDETTE MODEL V-50	R. E. THOMPSON MFG. CO.	$125.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Plenty of volume on local stations and brings in distant stations on loudspeaker when conditions are favorable.
MODEL 7	PFANSTIEHL RADIO CO.	$140.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Station finder engraved on the panel materially aids in tuning stations. Gives loudspeaker volume or local and semi-distant stations.
GN 2	GILFILLAN BROS., INC.	$140.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Three tuning controls according to the standard neutrodyne arrangement. Double range voltmeter on panel. Sensitive.
M.S. 24 Melco Supreme	AMSCO PRODUCTS, INC.	$140.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Selective and sensitive, inductively tuned with three controls. Compensating condensers controlled by dials so that various types of tubes may be used. Brings in distant stations on loudspeaker.
THERMIODYNE T F 6	THERMIODYNE RADIO CORP.	$140.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective, single control for tuning. Brings in distant stations on loudspeaker under favorable conditions.
MODEL XV	COLIN B. KENNEDY CORP.	$142.50	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Two tuning controls, brings in distant stations when conditions are favorable. Selective and sensitive.
MODEL R-100	SPLITDORF ELECTRICAL CO.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective. Brings in distant stations on loudspeaker when conditions are favorable.
BESTONE V-60	HENRY HYMAN & CO.	$150.00 Includes loudspeaker	Five tubes, "A" and "B" batteries and antenna equipment. Cost $65.00 to $85.00; $45.00 to $60.00.	Radio-frequency	Outdoor or indoor	Gives excellent results on local and distant stations when conditions are favorable.
MODEL N R-6	FREED-EISEMANN RADIO CORP.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Same as NR-12, listed under $100.00, above, but gives greater volume on distant stations.

TRADE NAME	MANUFACTURED BY	PRICE	ACCESSORIES NEEDED	TYPE OF CIRCUIT	ANTENNA USED	GENERAL CHARACTERISTICS
RADIOLA REGENOFLEX	RADIO CORP. OF AMERICA	$150.00	Four tubes, "A," "B" and "C" batteries, antenna equipment and loudspeaker. Cost $45.00 to $65.00.	Regenerative	Outdoor or indoor	Sensitive and selective. Arranged to operate on dry battery tubes. Gives excellent volume on loudspeaker from local and distant stations when conditions are favorable.
MRC-4	MICHIGAN RADIO CORP.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Tuned radio-frequency	Outdoor or indoor	Levers are used for tuning instead of dials. Sensitive and selective. Cushion sockets to cut out microphonic noises.
RADIODYNE W C 10	WESTERN COIL & ELECTRICAL CO.	$150.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor	Sensitive and selective, easy to tune. Brings in distant stations on loudspeaker when conditions are favorable.
TYPE X	WARE RADIO CORP.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $45.00 to $65.00.	Neutrodyne reflex	Outdoor or indoor	Gives best results possible with four dry battery tubes. Not adapted to storage battery tubes. Sensitive and selective. Operates loudspeaker on local and semi-distant stations.
SUPERDYNE	C. D. TUSKA CO.	$150.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Superdyne	Outdoor or indoor	Extremely selective and sensitive. Two tuning controls. Brings in distant stations.
M.S. 25 Melco Supreme	AMSCO PRODUCTS, INC.	$150.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	Highly selective and sensitive. Inductively tuned with three controls. Compensating condensers mounted on panel with dials so that receiver can be instantly adjusted for different types of tubes.
SYNCHROPHASE Type MU-1	A. H. GREBE & CO., INC.	$155.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Tuned radio-frequency	Outdoor or indoor	An entirely new system of condenser mounting and dial arrangement makes tuning easy. Highly selective and sensitive. Gives loudspeaker results on distant stations.
TYPE No. 102	FEDERAL TEL. MFG. CORP.	$156.00 Includes headphones and four tubes	"A" and "B" batteries, antenna equipment and loudspeaker. Cost $20.00 to $50.00.	Transformer coupled radio-frequency	Outdoor or indoor	Designed primarily for operation with dry battery tubes, but storage battery tubes may also be used. Two main tuning controls give selectivity and sensitivity.
ZENITH 3R	ZENITH RADIO CORP.	$160.00	Four tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $60.00 to $80.00.	Regenerative	Outdoor or indoor	Highly selective and sensitive. Three controls. Brings in distant stations on loudspeaker when conditions are favorable. Good quality of reproduction. Dry or storage battery tubes can be used.
NEUTROCEIVER	F. A. D. ANDREA, INC.	$160.00	Five tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Three dials control the tuning. Brings in distant stations on loudspeaker under favorable conditions and give plenty of volume on local stations.
INVERSE DUPLEX Type 2-S-4	MERCURY RADIO PRODUCTS CO.	$165.00 With loop	Four tubes, "A" and "B" batteries, loudspeaker. Cost $55.00 to $75.00.	Inverse reflex	Loop or antenna	Three vernier condensers used for tuning. Selective and sensitive. Gives loudspeaker results on distant stations under favorable conditions.
D-12	DEFOREST RADIO CO.	$165.00 Complete with loop	None	Tuned radio-frequency reflexed	Loop	This receiver uses four tubes and is sensitive and selective. Brings in distant stations with good volume when conditions are favorable.
TYPE W	WARE RADIO CORP.	$175.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Three controls. Brings in distant stations on loudspeaker when conditions are favorable.
TYPE B	EAGLE RADIO CO.	$175.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Sensitive and selective. Three controls with large knobbed dials make it easy to tune. Brings in distant stations on loudspeaker when conditions are favorable.
MA 15	MU-RAD LABORATORIES, INC.	$180.00	Six tubes, "A" and "B" batteries, loudspeaker and loop. Cost $70.00 to $90.00.	Transformer coupled radio-frequency	Loop	Sensitive and selective. One tuning control. Brings in local stations with plenty of volume and distant stations on loudspeaker when conditions are favorable.
STROMBERG-CARLSON	STROMBERG-CARLSON TEL. MFG. CO.	$180.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	Fully up to the best standards for neutrodyne construction. Three tuning controls. Will bring in distant stations on loudspeaker.
CONCERT GRAND MODEL S-70	R. E. THOMPSON MFG. CO.	$180.00	Six tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $70.00 to $90.00.	Neutrodyne	Outdoor or indoor	Selective and sensitive. Great volume on local stations and brings in distant stations with considerable volume when conditions are favorable.
TYPE No. 59	FEDERAL TEL. MFG. CORP.	$193.00 Includes four tubes and headphones	"A" and "B" batteries, loudspeaker and antenna equipment. Cost $40.00 to $60.00.	Transformer coupled radio-frequency	Outdoor or indoor	Arranged for operation on storage battery. Sensitivity and selectivity may be adjusted to suit local conditions.
TYPE V	GAROD CORP.	$195.00	Five tubes, "A" and "B" batteries, loudspeaker and antenna equipment. Cost $65.00 to $85.00.	Neutrodyne	Outdoor or indoor	In addition to the three dials used to control the tuning, there is a double-range, high-grade voltmeter to test the batteries. Selective and sensitive. Brings in distant stations on loudspeaker when conditions are right.
OPERADIO	OPERADIO CORP.	$195.00 Complete	None	Transformer coupled radio-frequency	Self-contained loop	A portable set that includes tubes, dry batteries and loudspeaker. Brings in local stations with plenty of volume and semi-distant stations when conditions are favorable.
RADIOLA Super Heterodyne	RADIO CORP. OF AMERICA	$220.00	Six UV 199 tubes, "A," "B" and "C" batteries, loudspeaker. Cost $34.00 to $55.00.	Superheterodyne	Self-contained or external loop	Highly sensitive and selective. Two tuning controls. Gives loudspeaker results on distant stations.
SUPER PORTABLE	ZENITH RADIO CORP.	$224.00 Complete	None	Tuned radio-frequency	Self-contained loop or antenna	A portable set that includes the loop. Can be operated without opening cover.
SUPER ZENITH Model VII	ZENITH RADIO CORP.	$230.00	Six tubes, "A" and "B" batteries, antenna equipment and loudspeaker. Cost $70.00 to $90.00.	Tuned radio-frequency	Outdoor or indoor or loop	Highly sensitive and selective. Two tuning controls. Gives loudspeaker results on distant stations. Dry or storage battery tubes can be used.
D-14	DEFOREST RADIO CO.	$371.50 Complete	None	Tuned radio-frequency reflexed	Self-contained or external loop	The circuit of this receiver is similar to the D-12 except that five tubes are used, giving the effect of nine tubes through reflexing. The cabinet contains storage "A" battery and dry-cell "B" batteries. Highly selective and sensitive. Gives great volume on local and distant stations.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins



A light for the radio cabinet

An Aid to "DX" Hunters

A PORTABLE electric light to set on the radio cabinet in order to light up the disks. This little device is made in Worcester, Massachusetts. Radio will soon have as many accessories as an automobile.

Shoveling with Air

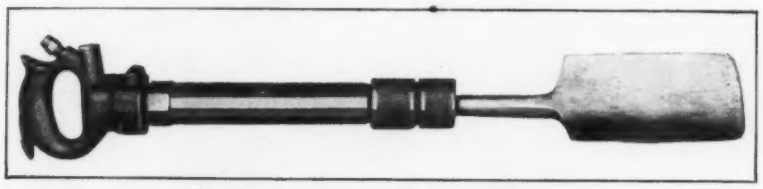
HAVE you ever noticed that the hardest part of shoveling in tough material is getting the shovel in? You push and you bang your anatomy against its handle, until part, at least, of a shovelful has been bitten off. But it is hard, killing work.

But suppose you had a helper whose job it was to strike with a hammer 800 blows per minute against the rear end of the shovel. All you would have to do would be to hold the shovel and keep it pointing where you wanted it to work.

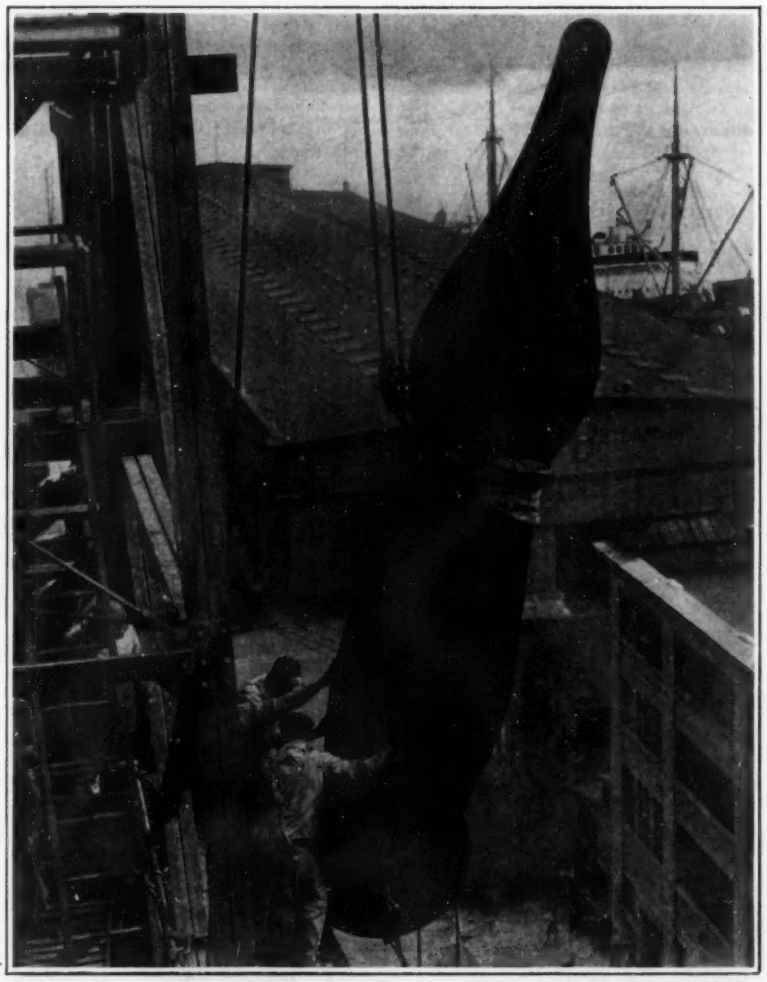
Such a consummation is contained in a one-man clay digger manufactured in Chicago. First, there is a pneumatic tool which does not differ greatly from the pneumatic riveter. This forms the handle and strikes the 800 sharp blows per minute. Then there is the shovel or spade, very strong and husky—much more so than a common hand shovel. The airline is a flexible hose which attaches to the handle end of the spade, and there is a hand trigger to start and stop the compressed air.

It does not require an engineer to see the potentialities of this combination. Anyone who has watched a pneumatic riveter mash rivets into heads in ten seconds, or a pneumatic chisel wrecking steel work knows how fast they eat their way through.

These shovels are not meant for shoveling coal or sand, but for tough jobs. For instance, cutting through frozen ground, tunneling in tough clay or digging postholes in "mean" soil.



This pneumatic shovel is a useful tool



Raising the gigantic minute hand of the new Colgate clock, the largest clock in the world. This hand is thirty-seven and a quarter feet long

A novel and useful orange peeler which speedily removes the skin

The Largest Clock in the World

THE largest clock in the world has just been shipped from the Seth Thomas factory to take the place of the old Colgate clock that for years told New Yorkers the time from its high position on top of the Colgate factory in Jersey City.

The diameter of the dial of this gigantic clock is fifty feet. The minute hand, from the counterbalance to the tip is thirty-seven feet, three inches long, the width of an ordinary city street. The mean width at the hub is three feet six inches, giving to the hand a visible surface of fifty-three square feet. There are 120 electric light bulbs dotted along the outside border of this hand in order that it may be seen at a great distance at night.

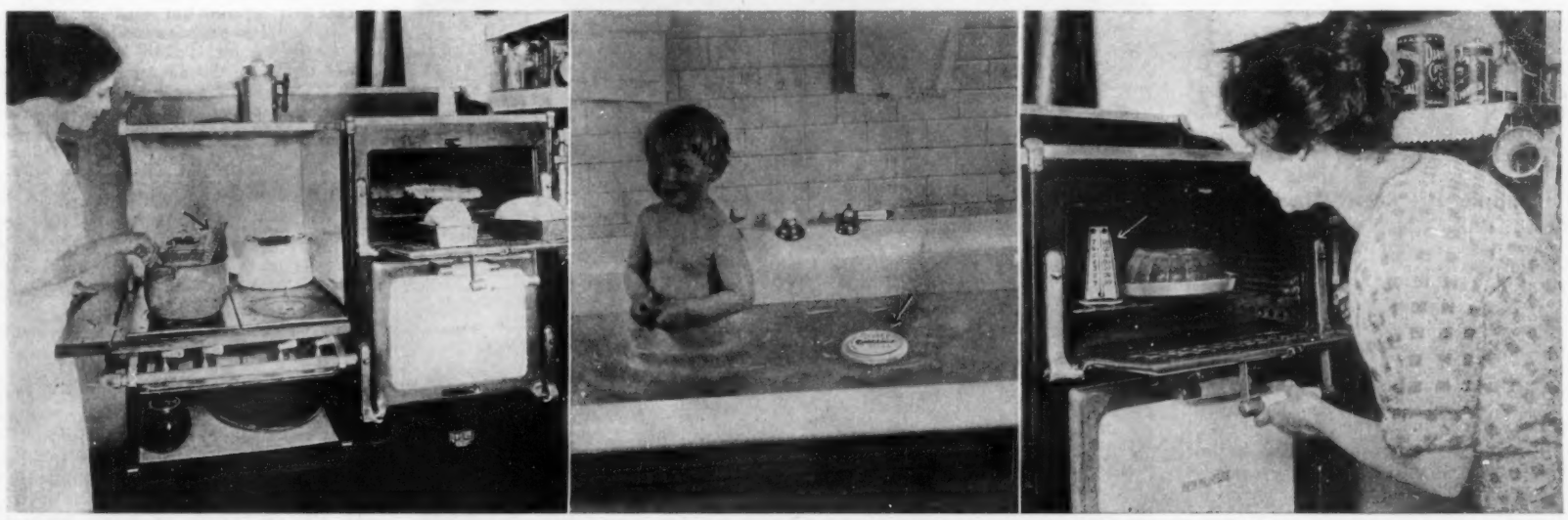
The hour-hand, twenty-seven feet long, is much wider, so, in spite of its being ten feet shorter than the minute hand it has a still greater visible surface. There are 100 electric light bulbs on this hand.

Both hands are built of seven-ply wood, with a reinforcement of structural steel. They are treated with a dull black finish which will bring them out distinctly against the white background of the huge dial.

The entire weight of the movement and the hands is about four tons.

Thermometers in the Home

IT is surprising that the use of the thermometer has not gained more popularity in the household. An established manufacturer of Rochester has been making a specialty of household thermometers adapted for special purposes. We illustrate three of them on this page. The use of a thermometer eliminates guesswork in preserving, canning, baking, candy making and cooking in general.



A thermometer for the household has many and varied uses. It is valuable for preserving (left); for the baby's bath (center), and for testing the oven temperature when baking (right). The correct type of thermometer must be used in each case

Portable and space-saving chairs

An Unusual Folding Chair

IN this device four chairs stack together in five inches of space and can be easily carried in one hand. But that is not the only interesting feature of this chair—they are decidedly comfortable.

They are made in several attractive finishes and would be quite in harmony with the furnishing of most any room.

The Atmospheric Scales

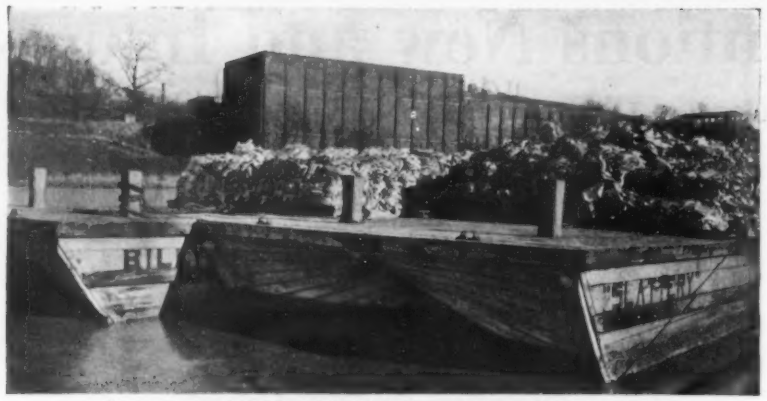
THE simple little scale shown in our two illustrations is the invention of a physician, Dr. Sverre Quisling. In its essentials it consists simply of a plunger working in a cylinder. When the scale is hung by the ring, any weight hooked on the little hook at the bottom of the scale plunger draws the latter down in proportion to the amount of weight on the hook. If it is desired to

The air-rarification scale

convert it to an air-compression scale instead of an air-rarification scale the ring and hook are unscrewed and two discs of metal having little screws in their centers are screwed on the opposite ends of the scale. The piston is kept air-tight by means of vaseline.

Cleaning Bricks by Machinery

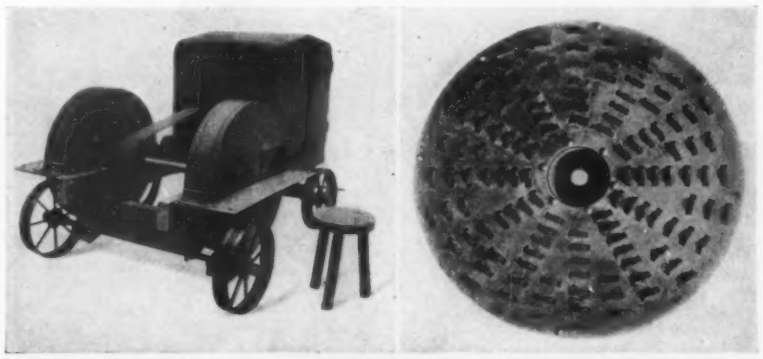
THE machine illustrated and two men can clean as many bricks as could six or eight men by hand. There are two cutter-heads so that two men can work at once. A two-horsepower gasoline engine drives the machine. The bricks are cleaned by being pressed against the side of a rapidly revolving cutter-head which quickly removes the mortar and gives the brick a true flat surface. The cutter has twenty-four radial rods on which rotate a large number of star-shaped cutters and round washers of the same size. These cutters are staggered in the head so that the whole face of the brick is cleaned. The cutter-head revolves at about 500 revolutions per minute.



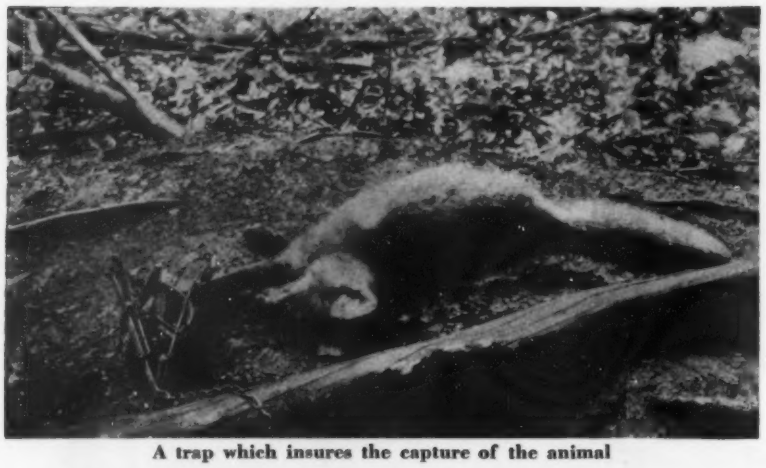
Greater speed is feasible with barges built like sea sleds

A Trap that Saves Pelts

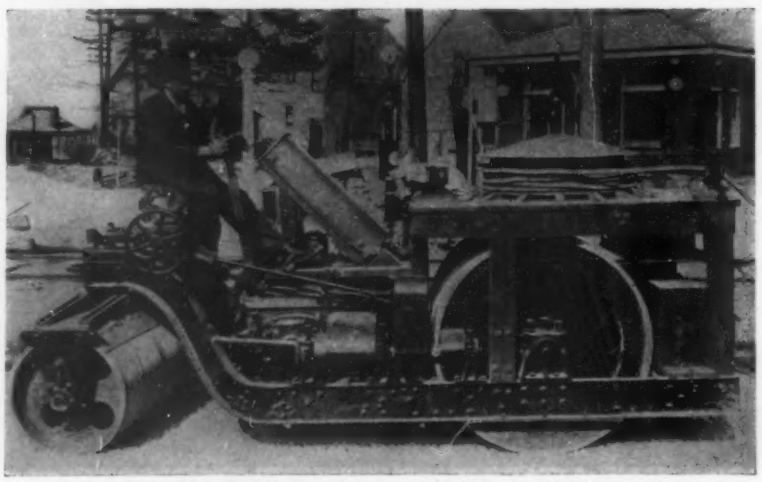
IN a novel coil-spring type of steel trap, an arm which rises above the trap when it springs, encircles the trapped animal's leg. The arm is mounted on a slide, and is drawn against the leg when the animal pulls to escape. A tightly closed and sealed poison or drug container is attached to this arm, and the trapped animal's attention is always attracted to it, with the result that the animal bites and ruptures the container and administers the poison or drug to itself. Six of these containers are furnished with each trap.



This machine and two men can more than triple the amount of work done by hand. Detail of the cutter-head, at the right



A trap which insures the capture of the animal



A road roller operated by power from trolley lines

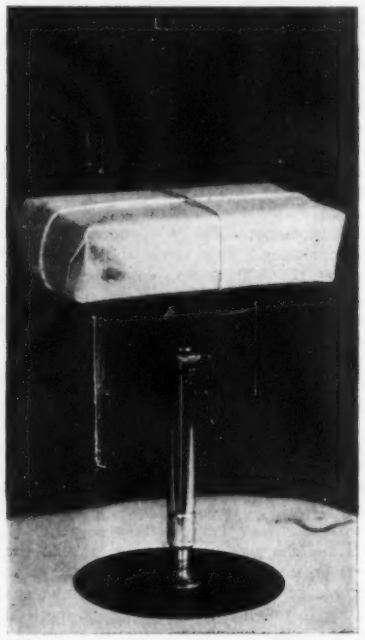
This device utilizes the exhaust gases to heat the oil strainer in the crankcase of a motor

Barges with Sea-sled Type Hulls

A NEW type of hull was designed to minimize wave formation in narrow canals, where previously the speed of barges had been limited owing to the danger of washing away the banks. This, of course, allows of higher speed in towing. The sea-sled type also requires less power. The construction is plainly shown in the illustration on this page.

Increasing the Flow of Oil

THE device illustrated above utilizes exhaust gases to heat the oil strainer in the crankcase of the engine for the purpose of allowing an easy flow of oil to the working parts of the engine. The inventor observed that oil in a crankcase becomes thick in cold weather and will not flow easily through a fine screen filter. This device



The same scale as the one shown in the first column but used as an air-compression scale

tends to obviate this by using a small portion of the exhaust by means of a valve. A choke wire opens the valve. This valve can be closed after the screen has become sufficiently heated.

Street Roller Operated by a Motorman Now

A MOTORMAN, instead of an engineer and fireman, operates the newest type of road roller, owned by the Milwaukee Electric Railway and Light Company. Electricity was decided upon when it was found that one of the company's steam rollers needed extensive repairs. A railway type motor and a type K controller with resistors, together with a mining locomotive cable reel, were used in remodeling the machine. The motor was so mounted that it drives the pinion previously driven by the steam engine. The electric roller is operating very successfully on streets where a trolley circuit is available to furnish power.

Away with spots

For Closing the Bulkhead Doors

A SINGLE turn of a wheel is sufficient to cause the bulkhead doors to close throughout a ship. This is the hydraulic system and the electrical plan is also used. In the Stone-Lloyd system two duplex double-acting pumps work perpetually at two strokes per minute, but once let the water pressure be decreased from the bridge, the governor automatically regulates the steam pressure and the powerful pumps shut the doors in twenty seconds.

An ironing board which folds up and fits into a trunk

A Folding Ironing Board

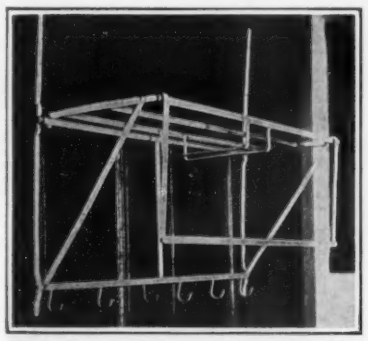
IF you are journeying away from the conveniences of home, slip this folding ironing board into your trunk. It is fitted with a substantial felt pad and a muslin cover which laces on. The size when folded is nineteen by nine inches and the weight is only three and a half pounds.

Speedy Spot Cleaner

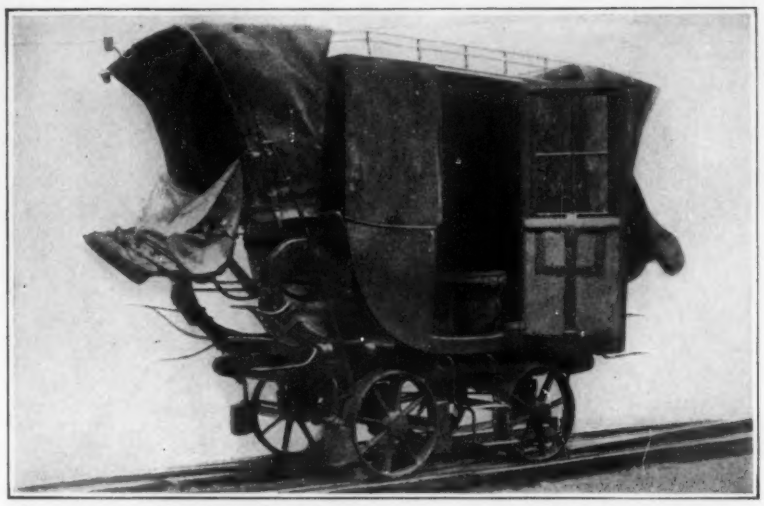
THE removal of spots on clothing is made easy by an ingenious arrangement of a glass bottle containing cleaning fluid, with its top a cloth cover. There is a valve in the top of the cover, and turning it upside down saturates the cloth top with cleaning fluid from the bottle.

Increasing Closet Capacity

THIS device hung on the inside of a closet door doubles the closet's capacity. There's a shelf for hats or shoes, two short bars for three suit-hangers each, a swinging bar for skirts or trousers and six large hooks for additional things. It can also be fastened to the wall with Moore hangers. It is made of rust proof, tempered aluminum and the weight is only eighteen ounces.



This device will provide much additional hanging facilities in your clothes closet



Compare this old-fashioned coach with our present-day Pullman cars. Coaches such as these were used when railways were a novelty. This uncomfortable affair is now in a museum in Vienna

The Edison Company constructed this, the first moving picture studio in the United States, in 1905. It was built on pivots so that it could be swung around to follow the sun and it was mounted on a truck to make it possible to move it from one location to another

Wheel on the bridge of an ocean liner used for automatically closing watertight bulkhead doors by the use of hydraulic power. An electrical plan is also used. Powerful pumps can shut the bulkhead doors in twenty seconds

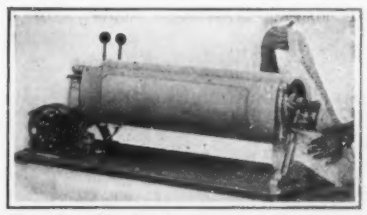
Useful device for the medicine chest

Half a Teaspoonful

THE device illustrated on this page is a divided spoon indicating exactly a half teaspoonful. It costs only a few cents and is useful in kitchen or medicine chest.

An Electrically Heated Ironer for the Home

THE ironer illustrated below can be heated either by electricity or gas and is operated by electric current. The ironer is only twenty-six inches long and weighs seventy-six pounds. The tendency is to make washday less of a bugbear by the introduction of such labor saving devices.



To take the drudgery out of ironing

An Old Railway Coach

WHEN railroads were new the coaches used were about the same as those used on the post roads. The uncomfortable affair illustrated here is in the Vienna Museum devoted to engineering. If you want to read about traveling in such a coach read the twentieth chapter of "Dombey and Son" and enjoy one of the cameos from Dickens. In this instance the carriage was Mr. Dombey's own, but the idea was the same.

A Direct Drive Electric Phonograph Motor

THE electric phonograph motor illustrated below is of interest because it is a direct drive, the slow speed feature being noticeable. The speed is 40 R. P. M. There is no "hum" and it will not overheat. In the phonograph cabinet it takes the place of the conventional spring motor and is fastened with four wood screws. The attaching cord is drawn through the hole in the side of the cabinet and is connected to an electric light or wall socket base. It runs at turntable speed without gear, belt or friction disk drive.

This motor takes the place of the conventional spring motor

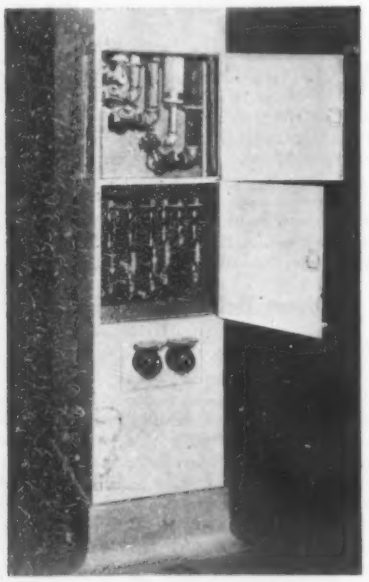
A practical dishwasher

Electric Dishwasher

YOU might judge the device illustrated above to be a washing machine but you would hardly spot it for a dishwasher. The bowl revolves at 240 revolutions per minute and the dish holder which is mounted on ball bearings revolves at 30 revolutions per minute. This holder revolves from the force of the water deflected by the stationary deflectors through the angular vanes of the dish holder.

Service Connections at the Cleveland Auditorium

THE citizens of Cleveland take a just pride in their $6,500,000 Auditorium, which will seat 12,000 persons, all of whom



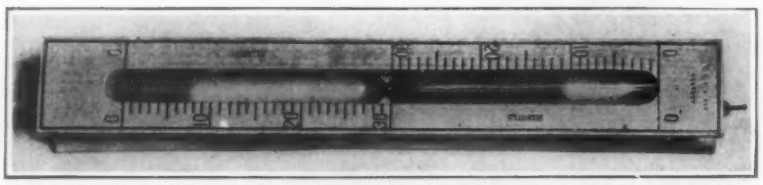
A novel service station

have an unobstructed view of the stage. On the great stage huge performances like "The Miracle" can be given. The pipe organ cost $100,000. In addition to the auditorium proper there is an exhibition hall one floor below, which is primarily intended for expositions. This hall, 121½ feet by 235 feet, contains 28,663 square feet of exhibit space.

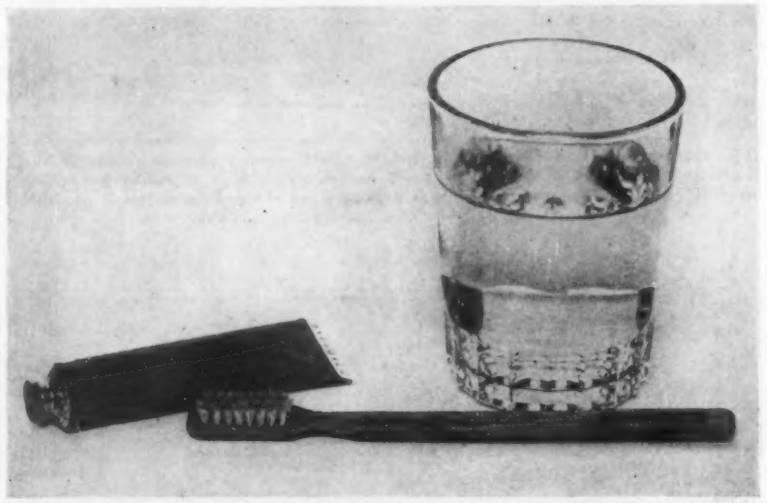
A service station is located five feet above the floor upon the north side of each of the forty columns which support the arena floor. The services provided at these stations include hot and cold water, compressed air, gas, high and low pressure steam, vacuum, vacuum cleaner, electricity, special service pipes for acids and drainage pipes for water and telephones.

Remove the olives unmutilated

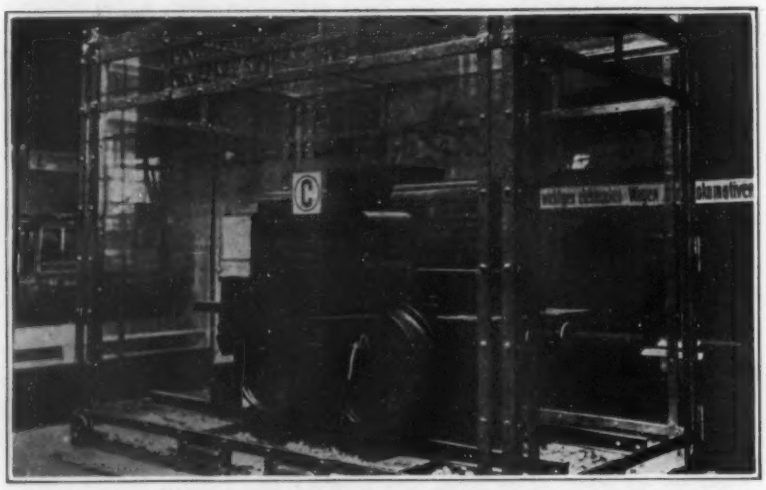
Rebore your cylinders in your own garage. In this portable boring machine there are no adjustments of cutting tools. Automatic feed to the boring bar can be applied at will



A practical egg-timer made on the same principle as the hour glass type but on which the time may be extended to a half hour. The construction is too simple to require explanation



A bamboo brush costing only five cents will appeal to all travelers. The brush we illustrate was made to the specifications of a dental surgeon. Note the shortness of the bristles, a practical feature



One of the earliest Siemens-Halske electric locomotives now in the Deutches Museum, at Munich, Germany

No tears when onions are cut under glass

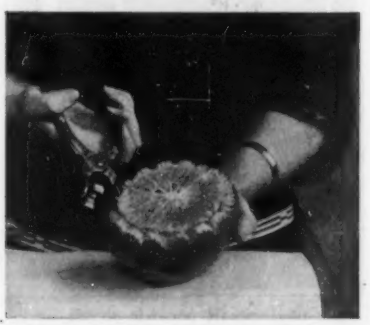
A Cylinder Reconditioning Machine

A PORTABLE eye boring machine (illustrated here) which can be attached to the motor on the chassis. It can be operated by hand or by electric drill motor. The machine is provided with a centering head that lines the boring bar perfectly with the bore of the cylinder. It bores holes at perfect right angles to the crank shaft regardless of how much the cylinders are worn. The tools are double-end cutters made to standard sizes.

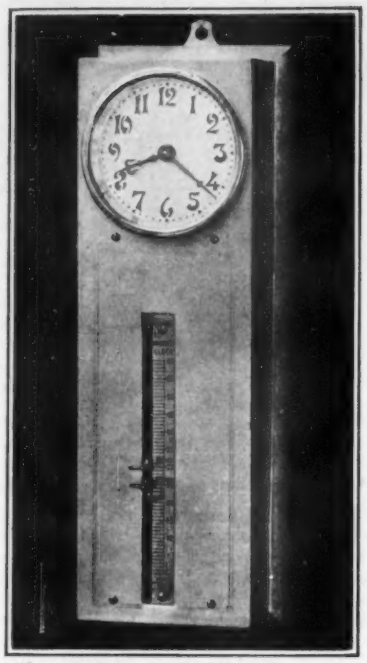
"Carving" in plastic wood

Plastic Wood

WITH a new preparation, called plastic wood, that can be moulded by hand into any conceivable form and hardens on exposure to the air to a tough, solid, waterproof substance similar to wood, but without grain, many services can be performed in repairing furniture or in making new things on the craftsman's bench. By use of this plastic wood the man of the house can salvage damaged furniture and can make new pieces with little expense or skill.



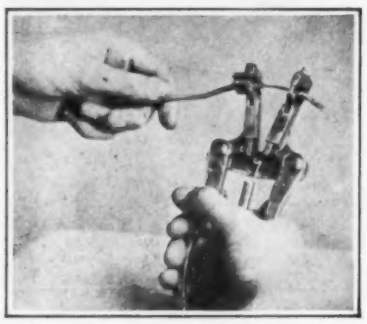
This fruit decorator produces some lovely designs



"Lest-we-forget clock" saves many mistakes. It can be set for any number of minutes, and then will sound an alarm

The Wire Insulation Stripper

THE device illustrated on this page has the general make-up of a pair of pliers and is handled in somewhat the same manner. It has two parts which correspond in position to the two jawnoses of a pair of pliers, but each of these parts is further

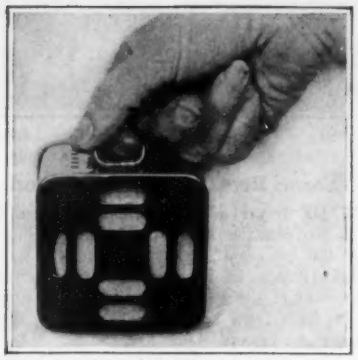


A tool for stripping insulation

particularized. There is a sort of vise for gripping the wire on the left side, and a neat little stripping device on the right.

In the illustration the two have been separated by the handgrip, but when you first attack a piece of insulated wire they are not spread apart. At that time the double jaw on the left-hand part will be open; while the device on the right hand part, consisting of corresponding notches which close down to the diameter of the metal part of the wire, is likewise ready to receive the wire. The latter is introduced sidewise (no threading through), the hand is closed on the handle, gripping the wire in the left

An unusually efficient whipping device for the kitchen. The action of the paddles makes it possible to whip cream in a very few minutes



This is not a coin bank but a moth chaser

part, and on the right biting the two parts of stripper down through insulation. The continuation of the closing motion of the hand pulls the latter away from the former, and with it comes, the last inch or so of insulation. In use, these apparently complicated actions are done in very brief time and with a single elided motion.

There are three separate "eyes" on the right-hand part, so that sizes 14, 16 and 18 can be stripped. Moreover, the two portions of the eyes can be removed and other sizes substituted. They are bevelled, so that the wire is not only stripped of insulation, but scraped, all in one motion.

Moth Chaser

WITHIN the metal container pictured here is a chemical of highly concentrated crystalline in disc form. It is to be hung in a clothes closet. As the chemical slowly evaporates it forms a vapor which is heavier than normal atmosphere. This vapor sinks to the floor of the closet or room in which the container is hung, and gradually rises in its fumigating process.

There have been numerous preparations devised for use in clothes closets and a number of them seem to have been successful.

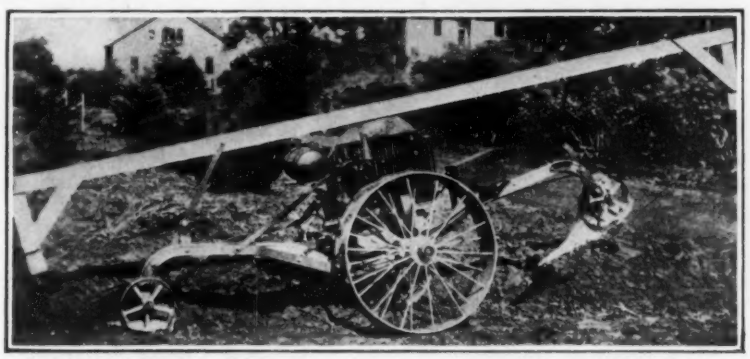
Eyeshades for the beach

Eyeshade in the Form of Eyelashes

A SIMPLE means of protecting the eyes from foreign substances is afforded by this novel eyeshade recently put on the market. It is made of a very light celluloid and bridges the nose, lying in the eye socket just below the eyebrows. In fact, it acts much as the eyelashes do, but with a greater degree of efficiency. It is particularly well adapted for use on the beach, inasmuch as it protects the eyes not only from blowing sands but from the glare of the sun as well. It would also be of value to the motorist who finds his sun-shield not always adjusted to the proper angle.

English Are Building Railways in Palestine

IN few ways has the English administration lent itself more to the economic development of the Holy Land than by the development of its railway system. With a standard gauge line from Egypt through Gaza and Lud in the coastal plain to Haifa, at the foot of Mount Carmel, one of the chief seaports, and another from the port of Jaffa, crossing this one at Lud, to Jerusalem, the chief economic centers are well connected with Egypt and the outside world.



An automatic plow is driven by a four-horsepower tractor. Right and left-hand plow bottoms are attached to the frame so that when one plow is working the other is carried up in the air out of the way. It was invented by an Iowa college professor

Installing an electric fountain in City Hall Park, New York City. Illuminated fountains are so beautiful that it is surprising that there are so few in use

Closgard wardrobe bag

A Serviceable Wardrobe Bag

THE wardrobe bag illustrated on this page consists of a strong, steel wire frame over which is hung a box-shaped bag of tightly woven cloth printed in gay colors. A special device (similar to the tight-closing tobacco pouch), as shown in the illustration, makes it easy to open the bag wide and easy to seal it tight. Weighs less than three pounds and hangs anywhere on a hook or a pole. It is ideal for the summer hotel where closet accommodations are often lacking.

The miniature laundry is almost exactly the same machine as is used in large laundries and can be placed in any sink or bathtub

The Vapotube Cigar Moistener

THE glass candy jar shown in our illustration is a home-made humidor, at one time fixed up in the offices of the Scientific American. What is wanted in a humidor is a way to get the right amount of water vapor distributed over a long time, and the little device shown resting beside the home-made "humidor" is for just that purpose.

This is a glass tube with cork plugs, having within a small tube of some white material resembling pipe clay. The cork is removed, the space inside is filled to within about three-fourths of an inch with water and then the vapotube is put in with a box of cigars.

A home-made humidor

Getting a coat of tan at home

Sunburn While You Wait

THE "sunburn" machine affords ample opportunity to the tired business man or woman who has little time to give to lying on the beach at the shore, in order to acquire a coat of becoming sunburn, to which so many aspire. By simply turning on the current, the ultra-powerful rays of this lamp will give the coveted coat of tan in a few sittings. This machine, which was exhibited at the New York Edison X-ray Show, promises to be popular with the stay-at-homes.

Not what it seems

A "Freak" Store

THE store front illustrated here carries out the architectural principle that the style should conform in some way with the use of the edifice. In the present instance the upper story houses a cold storage vault for furs, hence the dead wall.

Baby rides in comfort

Hammer head that stays on

A very large fur concern has a similar building, only of huge proportions. We visited it some months ago and saw millions of dollars' worth of furs in cold-storage vaults, protected from fire by a sprinkler system. Naturally the water in the pipes would freeze, so air is used instead and in case of necessity the water would follow the release of the air.

Baby in An Automobile

THE problem of a baby in an automobile has been solved by a number of devices of which this is a good example. The bassinet does not attach to the car; it stands on the floor or sets over the seat cushion. It can be used as a baby bath tub by simply laying a piece of rubber over the whole top of the crib, and pressing the rubber down to hold water and baby.

A Safe Hammer

IN the hammer illustrated the head cannot come off the handle, for the handle is fastened to the elongated shank in such a manner that it is physically impossible for it to come off.

A toter that can be folded up and carried with ease

A Boon to Mothers

A COMPOSITE baby car is the result of the ideas of a hundred mothers; certainly it seems like the product of more than one brain. It folds up for carrying on auto or train and can be taken into any store or other place. It weighs only six and three quarters pounds.

To separate the cream from the milk

Two well-made brushes

Some Brushes From England

THE buyer of a great metropolitan department store saw the nailbrush, shown at the left, at Harrogate and bought some. This brush is proving very popular on account of the good grip. The other brush also hails from England. The handle is of boxwood.

This brush is used for glazing anything in the kitchen which needs to be glazed.

Useful Vegetable Cutter

THE construction of a novel slaw cutter is clearly shown in the illustration on this page. It slices cabbage, potatoes or other vegetables with a speed that is positively uncanny.

An Aid to the Traveler

THE miniature washboard illustrated here is somewhat similar to the one which we showed in our issue of May, 1923, but is of a different shape.

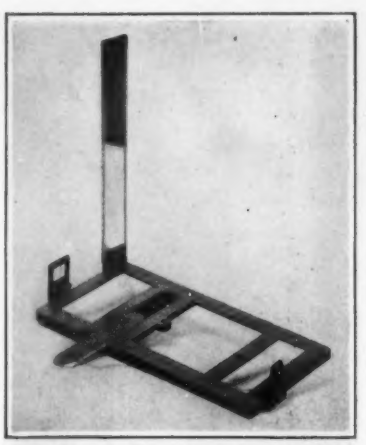
It will prove useful in traveling when handkerchiefs, neckwear or other small articles need to be washed.

A Novel Cream Separator

THE cream separator illustrated on this page is one of many devices on the market for taking the cream from the top of a milk bottle.

The illustration shows the operation of this useful device too well to require any further explanations.

A strongly constructed vegetable cutter



Instrument for measuring heights

A Device for Measuring Heights

THE mirror hyposometer serves to measure heights. It also may be used for leveling and measuring distances, and determining vertical angles. It is said that measurements may be made with an accuracy of one half of one percent. The device looks complicated, but with the directions and the table of vertical angles furnished, it is really very simple.

An aid to rapid dressing

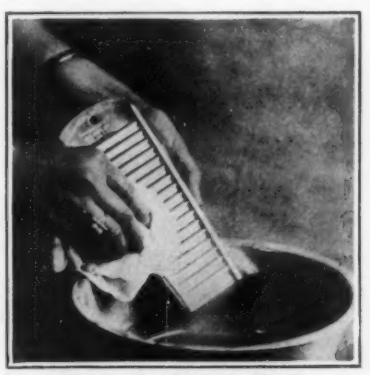
A Convenient Wardrobe Chair

DRESSING and undressing has at last been made a pleasure and fastidious grooming convenient.

We show a new wardrobe chair with a back shaped to receive a coat. A clip swings out for the trousers, drawers are conveniently placed for lighter articles. There is a shelf for shoes and a stand that rolls out to hold the foot while struggling with a knotted shoe lace.

In the boresome process of dressing this device will save a great deal of time and trouble.

The chair is made by a New York manufacturer.



For one's fine "hankys"

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Apparel

TROUSERS SUPPORT—Which will function, while remaining out of sight, to support the trousers and hold the shirt in proper position. Patent 1513522. J. E. Ross, 3607 Wyandotte St., Kansas City, Mo.

NECKBAND—Wherein a curved front is provided with the use of but two body members, yet presenting a four-ply band. Patent 1513700. D. Feigenbaum, 141 Roebling St., Brooklyn, N. Y.

ADJUSTABLE BUST-CONFINING GARMENT—Especially designed for stout women, arranged to distribute the flesh of the bust and hold it firm, giving a dressy appearance. Patent 1406692. Viola A. Smith, Mrs. D. McClellan Smith, 62 E. 77th St., New York, N. Y.

CAP—With a head receiving opening adjustable to heads of various sizes. Patent 1516284. S. H. Schneider and M. Fox, 1081 Tilden Ave., Brooklyn, N. Y.

BRASSIERE—Which conforms to the movements of the body, preventing its displacement as well as the displacement of the corset. Patent 1516658. A. Zwiebelson, 717 5th Ave., New York, N. Y.

Chemical Processes

COMPOSITION OF MATTER FOR TREATING FIBROUS MATERIAL—And cleaning the same, the composition including Irish moss jelly, paraffin, borax, stearic acid, soda ash, sal soda, carbonate of potash and water. Patent 1513316. Marguerite D. Easton, 502 W. 42d St., New York, N. Y.

METHOD OF TREATING WOOD—Employed for insulating storage batteries, by impregnating the wood with an aqueous solution of sodium bisulphide, sodium hydroxide and potassium permanganate. Patent 1515504. J. H. McDaniel, Box 412, Washington Court House, Ohio.

Electrical Devices

APPARATUS FOR REGULATING THE VOLTAGE OF ALTERNATING-CURRENT SYSTEMS — Effected by the insertion of inductance and capacity between the generator and a system being fed thereby. Patent 1513633. O. Scheller, c/o F. Warschauer, 111 Gitschiner St., Berlin, S. W. 61, Germany.

CONDUCTOR HOLDER—For telegraph or telephone lines, embodying means to prevent breaking the wires in several places at the same time. Patent 1512944. J. A. and W. Ness, Colman Ave., R. R. No. 3, Montevideo, Minn.

ELECTRICAL SWITCH—Of the push-button type, which will instantly close a circuit, but delay the opening of the circuit a predetermined interval after operation. Patent 1513901. W. F. Fulton, 968 Gary St., Shreveport, La.

MAGAZINE FUSE PLUG—In which the insertion of a wrong fuse is made impossible. Patent 1514479. J. Szykier, c/o B. Kugelman, Prinzregenstrasse No. 2, Berlin, Germany.

ELECTRICAL SWITCH—For wireless telegraphy, permitting a number of receivers to be connected and operated by the same switch. Patent 1515578. A. Glaser, c/o Shimel & Rittenberg, 37 Broad St., Charleston, S. C.

ELECTRIC SWITCH — Controlled by successive movements, by means of which certain functions are performed in order. Patent 1515932. F. D. Crowder, 635 Peterboro Ave., Detroit, Mich.

POWER CONTROLLER—For electric motors or the like, with means for supporting the lugs and resistances employed therewith. Patent 1515696. L. and F. Pignani, c/o S. W. Miller, Atty., Blairsville, Pa.

Of Interest to Farmers

PLOW—With means disposed convenient for the plowman to control the plow-share without stopping the plowing operation. Patent 1513559. J. N. Parker, Bedford City, Va.

HARROW SEAT—Having means for resting the seat upon two or more harrow sections, thus distributing the weight of the operator. Patent 1513145. F. H. Wilkey, Camp Point, Ill.

AGRICULTUEAL MACHINE—Provided with a pair of furrow making shovels and automatic adjustment to the inequalities of the surface being furrowed. Patent 1514045. J. W. Henry, c/o E. B. Hughes & Co., Gooding, Idaho.

WEEDER ATTACHMENT FOR SEEDERS — Capable of utilization with various types of seeders, for the destruction of weeds, at the time the seed is planted. Patent 1513749. E. B. Dodd, c/o E. Brookings, 500 Odd Fellows Bldg., Portland, Oregon.

ATTACHMENT FOR CORN BINDERS — Adapted to keep the corn in a vertical position during the time it is passing to the binder. Patent 1514304. A. Riehle, c/o A. A. Novak, Citizens Savings Bank, Spillville, Iowa.

GRAIN SEPARATOR AND CLEANER—Of the spiral type, for removing cockle, wild mustard and other spherical shaped seeds from wheat, rye and oats. Patent 1515776. H. Krussow, Hutchinson, Minn.

GRAIN-SAVING ATTACHMENT—For thrashing machines and shredders, adapted to be applied to the blower housing. Patent 1516545. L. J. Olson, Trosky, Minn.

Of General Interest

HATCH-COVER FITTING—So constructed that it may be opened to various positions at either of the four sides. Patent 1510305. W. W. Campbell, c/o A. R. Riddle, 25 Madison Ave., New York, N. Y.

CLEAT.—For securing a sheet by a clamping action, yet may be readily released, to run the rope freely. Patent 1510306. W. W. Campbell, c/o A. R. Riddle, 25 Madison Ave., New York, N. Y.

IRONING BOARD.—Of the collapsible type, characterized by lightness of weight and ease of manipulation. Patent 1511098. H. C. Armstrong, 110 Whittlesey Ave., Ashland, Wis.

DUMB-WAITER.—Having a lining of sheet metal which will present no portion on which articles placed therein could catch. Patent 1511171. Leroy H. Kiesling, 1797 Atlantic Ave., Brooklyn, N. Y.

RUDDER.—So constructed that the speed of a vessel and its direction of travel may be readily controlled. Patent 1511146. J. J. Toner, 2901-8th Ave., New York, N. Y.

HOLDER FOR THREAD COPS OR BALLS.—Capable of being mounted upon a chair or other article, to hold and feed the thread in knitting or crocheting. Patent 1511005. J. M. Powers, 407 Pelham Court, 2115 "P" St. N.W., Washington, D. C.

FOOD HOLDING AND SERVING DEVICE—More particularly intended for use in cafeteria service, permitting patrons to be served, with little delay. Patent 1511265. F. H. Chilson, R. I. Box 26, Palm City, Calif.

ANIMAL TRAP—With means for securing a steer in position where it cannot move, and where the head is clear. Patent 1510,832. R. W. Cudworth, 2912 Buchanan St., San Francisco, Calif.

DOORSTOP — Which when attached, will automatically lock a door in opened position. Patent 1511295. A. E. Moberg, 9 So. Mallory Ave., Batavia, Ill.

STOVEPIPE ANCHOR—For securing a stove pipe within a chimney opening and conceals the aperture. Patent 1511562. G. J. Huebner, c/o F. W. Stephan, 135 E. Main St., Fort Wayne, Ind.

KEY HOLDER—In which the key required may be located by the fingers and readily removed. Patent 1511563. G. H. Hufft, 1215 N. Main St., Tulsa, Okla.

VALVE—Especially adapted for use with pipe lines wherein water or steam are handled under pressure. Patent 1510820. P. Berdar, c/o S. S. *Floridina*, A. N. S. S. Co., Pier 28, San Francisco, Calif.

DOOR HOLDER — Affording facilities for holding a door open at any desired angle to the frame. Patent 1511368. W. Roberts, R. No. 9, Springfield, Ohio.

COMBINED SPONGE AND SPONGE HOLDER—In the form of a rigid handle presenting a means for holding the sponge. Patent 1511,969. H. A. Hoy, Box 834, Sioux Falls, S. D.

SIFTER-TOP RECEPTACLE AND CLOSURE THEREFOR—Which serves to effectively close, by spring action, the sifter opening against the escape of the contents. Patent 1511970. C. S. Humphrey, c/o Manhattan Can Co., Bush Terminal, Brooklyn, N. Y.

PENCIL—With a refillable lead and means for feeding it as used. Patent 1512779. G. R. McCabe, Elkhorn, Wis.

DOUBLE HUNG WINDOW—Which provides a substantially air and water-tight structure when the sashes are closed. Patent 1512741. S. U. Barr, 335 Carroll St., Brooklyn, N. Y.

CARD HOLDER—For use in holding labels or address cards in place on a container, to be sent by mail. Patent 1512332. C. T. Goewey, South Bend, Ind.

PLATFORM ATTACHMENT FOR WINDOWS—Adapted to be detachably secured to a window, for supporting a person to clean or repair the same. Patent 1512792. A. Nelson, Sauk Center, Minn.

MEANS FOR HANDLING GREASE COMPOUNDS—Which will deliver a predetermined quantity to the desired place and reduce the amount of handling. Patent 1512060. E. T. Schmucker, c/o Schmucker Service Station, Rapid City, S. D.

CARD HOLDER—Supporting a plurality of cards showing their entire face in such manner that they may be inserted or removed without injury. Patent 1513027. J. V. Belli, 251 Parker Ave., Clifton, N. J.

OUTLET STRAINER—For use in gutter outlets, that will not readily become clogged, or dislodged from its position. Patent 1513,650. E. S. Stanton, 50 Franklin St., Brooklyn, N. Y.

WINDOW—So constructed that the upper and lower sashes may be swung inwardly when access to their exterior is desired. Patent 1513657. C. Veri, 5 Farnham Ave., Garfield, N. J.

DRY-POWDER JELLY BASE CONTAINING PECTIN—In powdered or granular form, free from acid or sugar or any other foreign substance. Patent 1513615. H. T. Leo, c/o Leo Greenwald Vinegar Co., 515 No. Topeka St., Topeka, Kan.

EGG BEATER—Wherein the rotary action of a hand-controlled element will be converted into oscillatory motion. Patent 1512669. F. Benson, 253 Post St., San Francisco, Cal.

CREAM REMOVER—Which when inserted within an ordinary bottle of milk will automatically siphon the cream therefrom, is simple and sanitary. Patent 1512908. J. H. Cournyer, c/o Skimit Mfg. Co., 30 No. Michigan Ave., Chicago, Ill.

THERMOMETER — For use in connection with incubators, registering a temperature corresponding as nearly as possible the interior temperature of the egg. Patent 1514,535. J. Kovar, c/o H. Zdaril, Taylor, Texas.

Hardware and Tools

CAN OPENER—With a knife and a projection acting as means for holding the knife in proper operative position. Patent 1513,507. J. S. Hopkins, 10738 92d St., Woodhaven, L. I., N. Y.

HOLE ENLARGER—Which will pass through a well casing, and automatically spread and rotate to enlarge the space below. Patent 1512658. S. G. Woodruff, Route 2, Box 209, Inglewood, Cal.

COMBINATION SAW AND SQUARE—Wherein the upper edge of the saw blade forms one side of a square, a detachable connection forming the second branch. Patent 1514180. W. A. Spitler, Meyer Blvd. & Bellefountain Ave., Kansas City, Mo.

COMBINED STOVEPIPE COLLAR AND FASTENER—For firmly anchoring a pipe in the chimney hole and eliminating the use of wire supports. Patent 1515801. F. S. Sylvester and R. C. Markeski, 3057 Leeward Ave., Los Angeles, Calif.

HAIR CLIPPER—In which the handles are associated laterally, whereby the user may readily clip his own hair. Patent 1515422. E. A. Vetter, 146 Palmetto St., Brooklyn, N. Y.

SASH LOCK—Which includes a movable bolt, and means for yieldingly holding the same to a sliding sash of usual construction. Patent 1513308. G. A. Berry, Modesto, Calif.

UNDERREAMER — For enlarging a hole drilled into the earth underneath a casing, such as in a well. Patent 1513262. W. Newbrough, Box 434, Wilmington, Calif.

BENDING TOOL—That will allow a connecting rod to be bent while the same is fastened to the piston, to secure perfect parallelism. Patent 1514025. A. Stensrud, 257 Lester Ave., Oakland, Calif.

PRECISION INTERPUPILLARY AND BRIDGE MEASURE—Adapted for use by opticians in fitting nose glasses or spectacles. Patent 1515516. W. H. Oldach, c/o Scadron Optical Co., 23 Central Ave., Panama, Panama.

RAKE—In which all the teeth are firmly united, making it practically impossible for a single tooth to break. Patent 1514291. H. G. Kimber, 1633 25th Ave., Oakland, Calif.

TONGS—Adapted to grasp and lift a hot pan of any shape. Patent 1515038. E. J. Hamilton, 544 E. 22d St., Baltimore, Md.

MICROMETER — With visual indicating means responsive to the adjustment of the spindle and means for locking the parts. Patent 1516387. G. A. Kellerstedt, 1785 Stanley St., New Britain, Conn.

SELF-ADJUSTING BOW DIVIDERS—In which the legs thereof will always remain in parallelism and perpendicular to a line drawn between the ends. Patent 1515943. J. R. Engers, 1808 Elsmere Ave., Detroit, Mich.

PLIER WRENCH—Of the crossed-handle and locking-jaw and friction-gripped horn type, which is inexpensive to manufacture. Patent 1517162. P. F. King, 223 Meadow St., New Haven, Conn.

DOOR HINGE—Whereby the hinge elements are more firmly than usual supported in the door and jamb. Patent 1517205. E. Flagg, 111 E. 40th St., New York, N. Y.

Heating and Lighting

HEATING STOVE—With attachment adapted to draw in the surrounding air heat the same and discharge it from the upper part of the stove. Patent 1517215. M. W. McCullough, 63 Hancock St., Brooklyn, N. Y.

OIL BURNER—Wherein oil is finely divided in the presence of air before being discharged in a thin sheet. Patent 1513599. O. Kay, 1234 W. 76th St., Los Angeles, Cal.

STOVE ATTACHMENT — Adapted to be placed in the feed line of an oil stove for collection of foreign matter carried by the fuel. Patent 1514159. A. E. James, Box 214, Natchez, Miss.

FIRELIGHTER—Which may be saturated with kerosene or other inflammable substance and disposed beneath the grate for starting a fire. Patent 1515532. L. C. Werson, Cresco, Pa.

OIL BURNER—Of the retort type, which will constitute a heater. Patent 1516374. E. Darby, 1410 Falls Ave., Waterloo, Iowa.

RADIATOR COVER—Consisting of a one-piece cover and humidor which may be instantly placed in position over the radiator. Patent 1515963. R. L. Morrell, 19 S. Wells St., Chicago, Ill.

LAMP BRACKET—Adjustably mounted with respect to a common point, such as a worktable on which a plurality of severing machines are disposed. Patent 1516306. W. A. Rehorn, Jr., 50 E. 126th St., New York, N. Y.

Machines and Mechanical Devices

FOOD PREPARING MACHINE—Particularly adapted for cutting vegetables, fruits or the like, and enclosing the article cut. Patent 1512644. S. W. Smith, Lock Box 394, Hartford, Conn.

CASTING APPARATUS—By which the several operations attendant the positioning and filling of a flask with sand may be carried out. Patent 1512721. W. S. Sutton, c/o Am. Radiator Co., Rockford, Ill.

CAN CAPPING MACHINE — Particularly adapted to the affixing of paper covers on cylindrical paper shells. Patent 1511966. J. G. Hewit, 422 Gold St., Brooklyn, N. Y.

SHOCK ABSORBER FOR HYDRAULIC SYSTEMS—Wherein the shocks of the system may be taken up without disturbing the continuous pressure in the system. Patent 1512736. R. H. Aldrich, c/o Aldrich Pump Co., Allentown, Pa.

SASH FASTENER AND LOCK — Having mechanism adapted to automatically move to a locked position whenever released. Patent 1512855. P. Mayotte, Escanaba, Mich.

MOVING PICTURE MACHINE — Providing automatic tension take-up for reels when the film is being rewound on a spool. Patent 1512446. C. J. Barnes, 201 Carolina Ave., No., Goldsboro, N. C.

CARDING MACHINERY—Having automatic sliver evener adapted to be organized with such machine. Patent 1512267. W. W. Arnold, Jr., Manchester, Ga.

PAPER CUTTING AND PASTING MACHINE—By means of which wall paper may be pasted and cut to the desired width simultaneously. Patent 1512481. R. J. Paratore, 2030 Upperline St., New Orleans, La.

PISTON-GROOVE SCRAPER — Especially adapted for scraping carbon from piston ring grooves in pistons. Patent 1512110. E. B. Larson and W. H. Murphy, Van Hook, N. D.

PUMPING EQUIPMENT—In which the down stroke is utilized to lift a column of oil, and the plunger only a portion on its upstroke. Patent 1512500. J. B. Swartz, c/o Holmes, Yankey, Holmes & Eaton, 724 4th Natl. Bank Bldg., Wichita, Kan.

CLUTCH—With adjustable means for releasably holding the jaw members either in or out of engagement. Patent 1512760. P. R. Hancock, Kelso, Wash.

FABRIC CUTTER—Having means for automatically setting the cutting member and shifting the same after each cutting stroke. Patent 1513688. W. R. Barrett, 29 W. 54th St., New York, N. Y.

COMBINED ALARM CLOCK AND ARTICLE HEATER—Adapted to give an alarm, close an electrical heating circuit, and open said circuit when article is heated. Patent 1513685. A. Ardovino, c/o A. Cosentino, 343 E. 9th St., New York, N. Y.

REVOLVING ILLUMINATED PILLAR FOR ADVERTISING PURPOSES—Comprising a stationary base, an inner pillar either stationary or revolving, an outer revolving pillar, and a revolving cover. Patent 1513521. G. Robertson, 337 Carrington St., Adelaide, South Australia, Australia.

CENTRIFUGAL SEPARATOR — For use in separating lighter particles of a material from heavier particles, such as calcined colemanite from clay. Patent 1512687. H. D. Hellmers, c/o West End Chemical Co., Oakland, Cal.

BAILER—Especially adapted for use in oil wells, the mud being introduced through inlets on the downward thrust. Patent 1513,443. A. Boynton, 1019 City Natl. Bank Bldg., San Antonio, Texas.

GAS-VENTING APPARATUS FOR OIL TANKS—For preventing the accumulation of gas beneath the floating tanks or covers of large oil containers. Patent 1513043. W. S. Huff, 2113 W. Maple St., Stockyards Sta., Oklahoma City, Okla.

CLOTH-WINDING REEL—Whereby the convolutions of cloth can be held on the cylinder or released over the free end, as desired. Patent 1513054. P. H. Lipstate, Tyler, Texas.

WASHING MACHINE—Wherein the trays, containing the dishes, actuate the sprays only when the dishes are within range of the water. Patent 1512918. E. F. Forsgard, c/o Spell, Newman & Penland, Amicable Bldg., Waco, Texas.

COTTON PACKER—So constructed that the single element of motive power that drives the plunger in the press-box, shall also drive the feeder. Patent 1513458. E. A. H. Jacob, 407 North St., San Antonio, Texas.

CASING RING—Or elevator which may be conveniently attached to or removed from a casing, in oil well operations. Patent 1513,313. B. F. Conaghan, c/o E. S. Rutherford, Tonkawa, Okla.

BAILER BOTTOM—Having simple means whereby mud or the like may be discharged when churned on the derrick sill of a well. Patent 1513030. A. Boynton, 1019 City Natl. Bank Bldg., San Antonio, Texas.

AUTOMATIC CUT-OUT—Adapted for use in air lines to cut off the air when it reaches a predetermined point. Patent 1513064. N. G. Packard, Sand Springs, Okla.

COTTON CLEANING MACHINE — Whereby cotton bolls passing through the machine without releasing the cotton, will be retrieved and again submitted to the operation. Patent 1514044. V. D. Harlan, Humphrey, Ark.

AIR-BLOWING DEVICE FOR FUR-CUTTER'S USE—Causing a steady blast to be directed onto the fur, without the operator exposing his breathing organs. Patent 1514515. A. Goldsnyder and S. Goldstein, c/o S. Goldstein, 203 E. 9th St., New York, N. Y.

BREAD CUTTER—Whereby slices of a predetermined uniform thickness may be severed from a loaf, until the loaf is consumed. Patent 1513983. H. C. Greenbrook, 1636 N. Francisco Ave., Chicago, Ill.

SUGAR-EVAPORATING PLANT—Whereby the handling of the sugar juices in the various stages of their evaporation is simplified and expedited. Patent 1514482. M. and M. M. Terán, c/o C. Terán, Millburn St., Bronxville, N. Y.

ATTACHMENT FOR PRINTING-PRESS FLIES—Provided with means for engaging a leaf delivered by the fly, to press the same into position on a receiving tray. Patent 1515,498. J. La Scala, 263 Sackett St., Brooklyn, N. Y.

Medical Devices

SURGICAL INSTRUMENT — Having means for firmly securing towels in position, without being in the way of the operator. Patent 1516297. A. Isom and W. A. Bridwell, Dumas, Ark.

PAD FOR DENTAL IMPRESSION TRAYS—Which can be effectually pressed into position without undue discomfort to the patient. Patent 1517197. V. Cuttitta, 525 W. 47th St., New York, N. Y.

DENTAL DEVICE—For forming vulcanite dentures with dense smooth plastine surfaces free from imperfections. Patent 1517208. R. H. Gillespie and J. G. Vaughn, 202½ Main St., Pine Bluff, Ark.

Prime Movers and Their Accessories

VALVE ACTION — For use in connection with an explosive motor of the two-cylinder type. Patent 1513692. J. F. Brice, 60 Wall St., New York, N. Y.

BREATHER PIPE—So constructed that it combines several of the elements necessary to the successful operation of an internal combustion motor. Patent 1512947. V. W. Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn.

AUXILIARY AIR SUPPLY — For supplying air to the intake manifold of an internal combustion engine in accordance with its needs. Patent 1513142. H. G. Webb, Box 1733, Atlanta, Ga.

INTERNAL-COMBUSTION MOTOR—So constructed that the camshaft housing will be supported above and out of contact with the cylinders. Patent 1514066. V. W. Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn.

PISTON—With construction permitting of the examination or repair of the piston or rings without practically dismantling the motor. Patent 1514506. C. G. Cook, P. O. Box 275, Murfreesboro, Tenn.

INJECTOR FOR OIL ENGINES—Permitting the use of fuel oil of the lowest grade in motors of the two-cylinder or four-cylinder type. Patent 1515496. E. Laeubli, 475 American Ave., Milwaukee, Wis.

INTERNAL-COMBUSTION ENGINE—Of the two-cycle type with few moving parts which will operate with the least possible waste energy. Patent 1515529. H. C. Well, 522 W. 53d St., New York, N. Y.

INTERNAL-COMBUSTION ENGINE—Of the fluid piston type, which generates power directly in an associated turbine, in turn driving other mechanism. Patent 1515933. F. D. Crowder, 635 Peterboro Ave., Detroit, Mich.

Pertaining to Recreation

HOBBYHORSE.—In the form of an amusement device simulating a galloping horse operated by the rider. Patent 1510316. O. H. Gentry, 736 Garson Ave., Rochester, N. Y.

SCOOTER—Having a drive connection, a gear which permits of coasting, and brake-operating means. Patent 1511151. H. O. Wilson, c/o P. W. Greene, 610 Equitable Bldg., Wilmington, Del.

GAME.—A fortune telling game in which the answer is normally concealed but adapted to be brought to view. Patent 1509370. S. Nagase, 3169 Pine Grove Ave., Chicago, Ill.

BASEBALL-PITCHER'S PRACTICE TARGET—Simulating a catcher, designed for indoor work-outs prior to the starting of the season. Patent 1511430. A. O. Schonberg, 2001 Morris Ave., Bronx, N. Y.

AMUSEMENT APPARATUS—In the form of bowling game wherein the use of pins and pin setters may be eliminated. Patent 1512,739. S. E. Baker, 361 Market St., Johnstown, Pa.

GYROSCOPIC-CONTROLLED WHEELED TOY—Balanced and caused to travel along a predetermined course by the action of the gyroscope organized with the steering wheel. Patent 1513143. E. F. Welch, P. E. Frarow and J. Franklin, Box 157, Belboa, Canal Zone, Panama.

AMUSEMENT DEVICE—In the form of a swing which may be operated with safety by children. Patent 1514316. E. Hardy, Colchester, Ill.

TOY—Of the motor-operated type, traveling over a track under the influence of gravity. Patent 1515533. O. D. Willis, 633 14th St., Huntington, W. Va.

SOUNDING TOY—In which caps will be caused to be successively and rapidly detonated upon rotation of the casing. Patent 1515580. J. P. Keegan, c/o Transfer Metal Casting Co., 185 Christie St., Newark, N. J.

FIGURE TOY—Simulating a fisherman, with means for attaching the figure upon the edge of an aquarium. Patent 1517202. J. E. Engel, 1439 University Ave., New York, N. Y.

Pertaining to Vehicles

LIQUID-LEVEL INDICATOR—More particularly for use in connection with fuel tanks of motor vehicles. Patent 1512752. C. M. Fisk, Liberty Center, Ohio.

RESILIENT WHEEL — Whereby resilient support of a vehicle may be accomplished without the use of a pneumatic tire or springs. Patent 1513175. O. A. Ludwig, Box 1568, Great Falls, Mont.

TRACTOR HITCH—For connecting a trailing vehicle to a tractor, with a tendency to hold the tractor to the ground. Patent 1512611. M. J. Konetsky, 1642 Howard St., San Francisco, Cal.

TRANSMISSION—Particularly directed to a selective controlling mechanism for obtaining various speeds for motor vehicles. Patent 1513694. W. S. Cunningham, 2027 Elizabeth St., Shreveport, La.

SPRING PERCH—Which can be reversed so as to accommodate either long or short springs. Patent 1513042. J. L. Hartell, Brainerd, Minn.

RESILIENT WHEEL — Adapted to be mounted on the rim of a wheel of ordinary construction, providing pneumatic tire advantages. Patent 1513118. F. J. McNulty, Box 246, Victorville, Cal.

TIRE RIM—For the mounting or dismounting of either a straight-side or clincher type tire in the shortest possible time. Patent 1514436. C. Clausen, Bisbee, Arizona.

CLUTCH AND BRAKE OPERATING MECHANISM—For motor vehicles, successively operated by the movement of a single element in one direction only. Patent 1513905. A. J. Hiern, Martinez de la Torre 27, Tacubaya D. F. Mexico.

COMBINED AUTOMATIC AIR-PRESSURE EQUALIZER, LOW-PRESSURE ALARM, AND AUTOMATIC CUT-OFF FOR PLURAL PNEUMATIC TIRES—Adapted to be applied to valve stems of plural tires without changes in their construction. Patent 1513740. W. H. Brown, 610 So. Hudson Ave., Pasadena, Calif.

VALVE TESTER—For discovering leakages in the valves of pneumatic tires on motor vehicles. Patent 1514033. W. A. Cannon, Carmel, Calif.

DRIVING CONNECTION—Which will eliminate the common troubles with respect to the stripping of the differential ring gear. Patent 1514522. H. J. Hilmes, Altamont, Illinois.

LIQUID SPREADER FOR WINDSHIELDS—With means for spreading a transparent liquid, which prevents deposits of mist, snow or sleet, and insure a clear vision. Patent 1514340. R. L. Rice and W. M. Jordan, 1716 20th Ave., Gulfport, Miss.

DISK WHEEL—For use in conjunction with the ordinary type of artillery wheel hub, thereby eliminating a special form of hub. Patent 1513742. A. J. Charlton, Lowden, Iowa.

RUNNING-BOARD MAT—Which is hingedly connected and can be swung under the running board until desired for use. Patent 1515449. E. N. Vose, c/o R. G. Dun & Co., 290 Broadway, New York, N. Y.

TIMER — For automobile engines, with means for preventing the accumulation of dirt and other foreign substances, on the device. Patent 1515531. H. C. Wilber, So. Main St., Tuscola, Ill.

DEMOUNTABLE RIM—Which may be very quickly applied to and removed from the tire of a wheel. Patent 1515538. O. B. Bachman, 526 Hellman Bldg., Los Angeles, Calif.

POWER-TRANSMITTING DEVICE — Adapted to various sizes of wheels regardless of whether the wheels are of artillery, disk, or wire construction. Patent 1515054. W. H. Kadesch, 1109 Main St., Cedar Falls, Iowa.

SPRING SUSPENSION FOR VEHICLES — Which will prevent the likelihood of the vehicle tipping to sideway and relieve other disagreeable shocks. Patent 1514303. C. A. Rasco, Samoa, Calif.

COWL VENTILATOR AND FILLING OPENING FOR COWL TANKS—With operating means whereby the opening may be controlled from the driving compartment of the car. Patent 1516403. V. W. Page, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn.

MACHINE FOR ASSEMBLING SPOKES IN WHEELS—Which affords facilities for assembling spokes in a wheel without the necessity of heating the felloe member. Patent 1516328. J. E. Broxon, 1026 Marion Place, Akron, Ohio.

WHEEL LOCK—Whereby the driving connection between the steering post and the wheel may be broken, to prevent unauthorized use of the vehicle. Patent 1516418. H. P. Woodward and W. A. Lowery, c/o Lowery & Blakman Co., Atlanta, Ga.

BRAKE BAND CONSTRUCTION—Which may be removed from a brake drum without the necessity of removing the wheel from the vehicle. Patent 1515956. G. R. Le Maire, c/o Cocke Sales & Service Co., Central City, Ky.

PUMP—For inflating tires, which has a direct stroke and complementary leverage stroke, with greater pneumatic pressure. Patent 1515662. W. R. De More, Box 45, Jacksonville, Fla.

RADIATOR WITH REMOVABLE ELEMENTS—Retained in a manner allowing of their removal and replacement in case of leaking or injury. Patent 1517155. H. R. Guyot, 54 Avenue Jean Jaures, Paris, France.

DIRECTION INDICATOR FOR AUTOMOBILES—For indicating on both sides of the vehicle, the direction in which the vehicle is about to turn. Patent 1516538. R. E. Lunday, c/o Keystone Hotel, San Francisco, Calif.

METHOD AND MEANS FOR THE REGISTRATION OF MOTOR VEHICLES—So that the theft and subsequent alteration of identification marks may be readily detected. Patent 1516547. W. D. Powell, 1025 9th Ave., South Fargo, N. D.

GLARE SHIELD—Which may be readily attached to an automobile top and instantly adjusted at will to any position desired. Patent 1516776. F. C. McGuire, 102 N. Charles St., Macomb, Ill.

Designs

DESIGN FOR A CLOCK CASE—Patent 65353. M. Salinger, 24 E. 99th St., New York, N. Y.

DESIGN FOR AN INCENSE BURNER—Patents 65867 and 65868. S. Morita, c/o Nippon Trading Co., 420 Grant Ave., San Francisco, Calif.

DESIGN FOR A LETTER OPENER — Patent 65916. J. C. Kortick, 335 First St., San Francisco, Calif.

DESIGN FOR A COMBINED LAMP AND SOUND AMPLIFIER—Patent 65931. S. Sadler, 86 Fourth St., San Francisco, Calif.

The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests appear elsewhere in this issue

Conducted by Albert G. Ingalls

Is the Steel Riveter Doomed?

CUTTING out the materials of a steel-framed building just as a tailor cuts cloth and then welding these pieces together into a one-piece structure is the newest way to look at the construction of skyscrapers. Electric arc welding is beginning to make this sort of thing possible. If it works out as well as its proponents believe it will work we shall hear the penetrating rat-tat-tat-tat of the pneumatic riveter only a few years more. Few listeners would object.

There are three important methods of uniting two or more pieces of steel. The first is by riveting, a method nearly everyone is familiar with. The second method is by gas welding. An oxy-acetylene flame is directed upon the pieces of steel to be joined while the end of a rod of steel is held in the zone of fusion. The third method is electric welding, of which there are two varieties, resistance welding and arc welding.

In resistance welding the two surfaces to be united are brought in contact, a powerful electric current is passed from one to another, heating the junction, and the two pieces of steel are then pressed together. Spot welding is a variety of resistance welding which is widely used. The two steel sheets to be welded are placed between electrodes which force them together under heavy pressure. When the current is turned on the spot between the electrodes is heated by the passage of the electricity and a fusion takes place only at that spot.

The other form of electric welding is arc welding—the joint or weld is made by means of an electric arc between a steel wire fixed in an insulated holder and the pieces of steel to be welded. The electric arc is formed by touching the electrode to the steel plate and then withdrawing it a short distance. The wire melts in the hot arc and is fused with the molten steel of the parts to be welded. This is the variety of welding practice that is now beginning to be used for the erection of steel frame buildings.

Why abandon riveting and adopt welding? Because, it is argued, welding is more economical. When you see a steel building being built, stop and think how many processes the parts of the framework must go through. First there is the design; then the making of drawings; then the making of templets which are laid on the uncut pieces of steel and drawn around, much as a seamstress draws around a paper dress pattern. Then the holes indicated by the templets must be drilled for the rivets; the individual pieces must be assembled and riveted into units such as trusses. These are next painted in the shop, sent to the site of the future building and erected. Finally they are painted again.

The same building could be built by welding with about half as many steps as those just described. After the design was made, the drawings (much simpler without rivet holes) would be made; the joints would be cleaned, arc welded and painted. That is all.

If buildings made in this manner can be relied upon to stand up in long-time service, the saving in human labor will be great. The welded joint, it is claimed, can be made as strong as the parts themselves, while the corresponding riveted joint is rarely equal to seventy-five percent of the strength of the parts. This means a saving in weight of material and a consequent saving in cost of material and freight on its shipment.

Courtesy of General Electric Co.

The method of joining steel building parts which replaces the noisy riveter, does away with punching holes and saves money

Accurate alinement of parts will not be necessary, since there are no rivet holes to line up closely with corresponding holes on other pieces. Welded joints are also tight to oil, water or gas.

A combination of all these factors makes it possible to produce, with the use of welding, a structure which is cheaper and better than the ones constructed by riveting. The savings, according to some authorities, amount to from ten to twenty-five percent of the total cost.

It would not be accurate to state that arc welding as a method of building construction is yet on a fully developed basis. There remain several metallurgical problems to be worked out. Data must be gathered, for example, on fatigue and strength of welded joints. Experience is needed. See *The Iron Age* (New York) vol. 114, pages 1211—1212 (November 6, 1924); *Journal of the American Welding Society* (New York) vol. 3, pages 11-69 (October, 1924); also a paper (25 pages) presented by Prof. F. P. McKibben of Union College before the Schenectady Section of the American Society of Mechanical Engineers and the American Welding Society (issued by the General Electric Company, Schenectady, N. Y.).

Thick Blankets Are Not Always Warmest

TESTS made recently by the Bureau of Standards at Washington show that blankets of moderate density keep the indoor sleeper warmer than those which are closely woven or dense; also that cotton blankets can be used over sheets to good advantage by all except those who, like campers, sleep where it is damp.

Blankets have been used by man for so many thousands of years, that they have become a commonplace. Few scientific tests have ever been made on them. Most people take it for granted that a thick blanket is warm, especially if it is tightly woven; and that a thin blanket is correspondingly colder. Within certain limits this is true. But there is such a thing, says the Bureau, as putting so much fiber into the blanket and thus leaving so little space between the fibers that the fibers themselves become conductors of heat. Thus the blanket actually cools us, just as the thin cooling fins of an automobile radiator cool the tubes and the water within them.

What, in a scientific sense, is a blanket? It is only a convenient device for surrounding ourselves with several layers of non-conducting bubbles of air. Air is the best insulator of heat that is available. It is also the cheapest. The tiny spaces between the fibers of the blanket constitute these insulating air cells.

What we want in a blanket is the correct balance between the size of the air spaces and the space taken up by the fibers. If there are too few fibers the air will pass in and out of the contained air cells too freely. We shall always be warming up new air. If, on the other hand, there are too many fibers there will be little space left for dead air to act as an insulator, while the fibers themselves will conduct heat away from our bodies.

When we wish to sleep in the wind or in a strong draft we must prevent the pressure of the moving air from driving out the dead air from the cells between the fibers. The simplest way to do this is to increase the number of layers of these air cells. This may be done by increasing the thickness of the blanket. The wind will penetrate the outer layers, but it will have little strength left to effect the air in the inside layers.

In the recent test at the Bureau of Standards nothing was left to human judgment. The blankets were wrapped around a square metal plate which was heated electrically. Since it was easy to meter the amount of electricity needed to keep this metal plate at a given temperature, the ability of any one blanket to prevent the escape of heat could be ascertained without error.

The Bureau finds, also, that cotton blankets resist the passage of heat about as well as blankets of wool, and believes they should be used more widely. Cotton tends, however, to absorb moisture, while wool repels it. That is why a cotton blanket feels cold and clammy when one first gets into bed under it.

Technical Paper No. 226 of the Bureau of Standards, explaining these tests, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for ten cents.

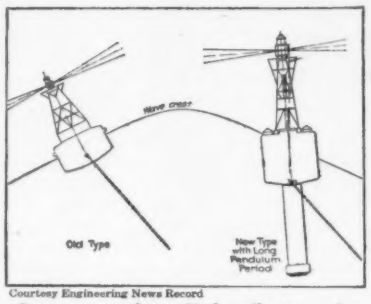
* * *

Telephone Customs Around the World

IN England when you telephone and the line is busy the operator, who is there called a "telephonist," says, "I am sorry, the number is engaged." In Sweden the telephone operator announces herself with a number, such as "four seven," in the Swedish equivalent. This gives her position at the switchboard. In Paris the operator announces herself by saying the equivalent of, "I am listening." In Germany, instead of giving a number in digits as we do, for instance two-five seven-eight, they say the equivalent of twenty-five seventy-eight. In German this takes the form of five and twenty, eight and seventy.

What happens in the former realm of the Tsar is still less pronounceable.

In Switzerland, where the operator must know both French and German, the answer corresponding to, "The line is busy" is, "The number 0000 does not answer." Japan refuses to be short even over the telephone. The operator opens with the greeting, "Moshi, moshi," and then "Nuban," meaning "Number, please." When Sir Herbert Tree attempted in the United States to use the English equivalent of "Hello," which he considered a violent, nerve-racking word, the reply to his "Are you there?" was, "Say, where the devil do you *think* I am?"—*Telephone Review* (New York) vol. 15, pages 321-322 (November, 1924).



Courtesy Engineering News Record

Great waves have little effect on the swing of the new government buoys shown above

Taking the Swing Out of Ocean Buoys

No matter how large the waves may run, the lights of the newest buoys of the Lighthouse Service will not nod themselves out of view. No matter how calm the sea the thousand-pound bells which are also carried by these immense buoys will continue to ring.

The older type of buoy shown at the left side of the accompanying cut swings on the waves just as a boat does. The result is that its beam of light, which is focussed to a narrow angle in order to make it stronger, is visible from the decks of distant ships only when it passes the horizontal part of its swing. This is a serious objection to such a buoy for the reason that many of these buoys have set periods of light and darkness. They flash over and over in certain ways that identify them to seamen.

The seaman times the flashes with his chronometer. Let us say he finds that the buoy flashes light for seven seconds; is dark for three seconds; flashes again for four seconds; and is again dark for nine seconds. No other buoy in the world flashes in this exact manner. Thus he knows where his ship is.

Now, if the waves cause the buoy to swing its beam of light up out of view or down out of view the seaman will have difficulty in determining just how often the buoy does flash.

The new government buoy, however, is constructed in such a manner that the waves do not swing it much. The long extension with a heavy weight hanging twenty-two feet below the surface of the sea keeps the buoy in a nearly vertical position no matter how large the wave that passes. The whole buoy is thirty-nine feet from top to bottom and weighs eighteen tons.

Having thus provided that the waves will have little effect on the swinging of the buoy, merely raising it up and down as they pass, we have apparently defeated ourselves in another direction. For the fog bells of bell buoys have always been kept ringing by the motion imparted to them by the waves.

A new way to do this has been found by means of gas stored under pressure inside of the buoys. The gas used is carbon dioxide, the gas that makes the fizz in both soda water and champagne. The buoy carries three large tanks of this gas, enough in all to ring the bell steadily for four months.

The gas slowly escapes through an asbestos-packed choke valve to a small chamber. When its pressure there reaches about 275 pounds per square inch it is automatically released against a piston. When the piston moves out, the 1,000-pound fog bell rings. This action takes place every fifteen seconds.

The lighting of the buoys is done from a tank of acetylene gas which contains enough gas to keep a 480-candle power light burning continuously for a whole year without attention.—*Engineering News-Record* (New York), vol. 93, pages 783-784, Nov. 13, 1924.

Little Journeys to Scientific Facts

THOSE who are interested in science often find themselves in the position of realizing that some new art or the product of some piece of research is becoming so important that one has to know about it. "Just when did this thing start, and what is its general background?"—how often one asks such a question! Filling in such a background is a difficult task.

For instance, there is bakelite. Six or eight years ago bakelite was only a trade name among many trade names. Today bakelite is almost as common a material as wood. "Where did bakelite come from? I want to find out without hunting through several volumes."

The little volume entitled "Popular Research Narratives," tells as much as the average man needs to know about bakelite, and tells it in only seven hundred words.

And so of electric welding, of helium, of American optical glass, of the new feat of measuring molecules and of forty-six similar subjects.

These narratives are not written for the reader who knows no science whatever. Rather they appeal most strongly to people who enjoy science, who sometimes read science, but who do not like to be overwhelmed by the technicalities of some particular corner of science when they want merely an idea of the whole.

The fact that these concise accounts are issued by the Engineering Foundation, which is the joint research instrumentality of the American Society of Civil Engineers, the American Institute of Electrical Engineers and other societies of similar high rank, assures these little essays the imprimatur of accuracy and authenticity.

* * *

Listening to an Electron Rainstorm

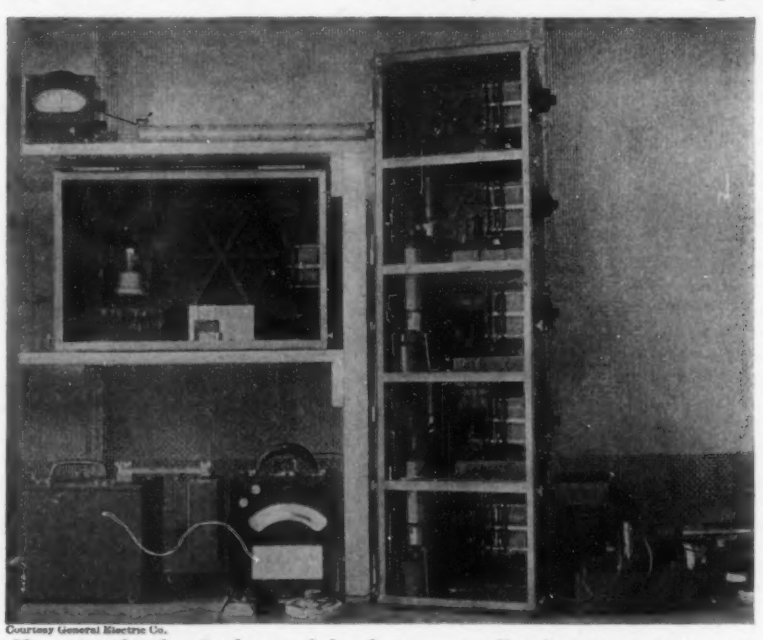
BEATING a tattoo like heavy rain on a tin roof, the impacts of a shower of individual electrons striking against a metal plate have just been heard by two American scientists, using a modified radio apparatus which amplifies the impacts more than one hundred thousand times.

Most radio fans know that when the filament of a vacuum tube is lighted the inside of the tube is bombarded by a continual shower of rapidly flying electrons driven off the hot filament. When the grid of the vacuum tube, which is placed between the filament and the plate, is charged positively it acts just as the white-gloved hand of a traffic policeman acts on motor traffic. It says, "Go ahead." Thus the tiny charge coming in from the aerial releases many times its own equivalent of electricity. This released electricity reaches the plate and duplicates on a larger scale the characteristics of the incoming current. This is how the vacuum tube amplifies and how we are enabled to hear weak radio signals.

These electrons that do all this work are so small that the strongest microscope would fall ridiculously short of making them visible. There are billions of them in the smallest speck of dust. Nevertheless, by putting the electrons through various performances and by observing the effects they produce we can find out nearly as much about them as if we could see them. One such effect is the one we have just mentioned—we amplify the impact of the tiny electronic particle one or two hundred thousand times and then convert the amplified electrical energy into the equivalent energy of sound. Thus it effects our eardrums.

To do this, Dr. A. W. Hull of the research laboratory of the General Electric Company at Schenectady, New York, and Dr. N. H. Williams of the University of Michigan, who did this recently, employed five stages of radio-frequency amplification. They were able, by adjusting very critically the number of electrons which fly from the hot filament and strike the plate, to limit their number from the usual millions per second to a comparative few, so that the combined impacts, when amplified, sounded in the telephones like rain on a roof.

Listening to a rainstorm of electrons is interesting enough, but the two scientists regard this merely as incidental to a more important work. They are actually measuring the electric charge carried by but one single electron. The 1923 Nobel Prize for physics was awarded to Dr. R. A. Millikan for making this same measurement. The two scientists named did the same thing in a different way, so that the accuracy of Millikan's work could be checked. The results thus far obtained give a value of the charge of the electron which agrees within one part in two hundred of that obtained by Millikan.—From a statement issued by the General Electric Company (Schenectady).



Courtesy General Electric Co.

Measuring the electric charge of the electron, as well as listening to its impact against a plate was carried out by means of this apparatus

* * *

New Diesel Engine Uses Both Strokes for Power

EXPECTED to mark an epoch in the development of the Diesel or fuel-oil engine, a new reversing, two-cycle engine of this type has just been brought out by the Worthington Pump and Machinery Company (New York). This engine obtains more power from a given engine weight than has hitherto been practicable with a Diesel engine of this type.

The Diesel engine, it will be remembered, burns low-grade fuel oil and ignites it, not with a spark, but by means of the great heat generated when the oil-and-air mixture which is injected into the cylinder under pressure is highly compressed by the momentum of the flywheel. In the ordinary gasoline engine the compression is too low to heat the charge of

gas mixture to the point where it will take fire spontaneously. The Diesel engine, so-called from the name of its inventor, is very much heavier than the common gas engine and has found its chief use, so far, in the propulsion of ocean-going ships. Here larger and larger Diesel engines have been put in use, especially since the World War, until the largest power unit at present installed in any ship is twenty thousand horsepower.

It is believed by many that the lowered cost of ship propulsion made possible by the Diesel engine ought to put back in operation a large number of American ships which are now idle at their docks. In the case of the four-cycle Diesel engine every other revolution of the downstroke of the piston is a power stroke. This corresponds to the four-cycle automobile engine. The two-cycle Diesel engine, however, gets a power thrust on each downstroke of the piston. But the new double-acting two-cycle Diesel engine gets power both on down stroke and up stroke, just as a steam engine does.

The double-acting Diesel engine idea is not a new one, of course, but the difficulty of constructing a double-acting Diesel engine that would stand up to heavy duty under the complicated stresses due to heat expansion on the various parts has previously interfered with the successful application of the idea. The success of the new design, therefore, is said to be due to the manner in which the problems of expansion and heat removal are solved.

The cylinder walls of forged steel are designed for the lowest amount of minor change in shape. By freeing this cylinder wall structure from all rigid connection with any other structure, further release from stress due to heat expansion is obtained. The outside casting is simply a water container for the cooling water and has no organic connection with the cylinder walls. In addition to this, the material of which the cylinder walls are made is more ductile than most cast iron and this permits excess stresses to adjust themselves to a considerable degree.—*The Iron Age* (New York), vol. 114, pages 559-560 (Sept. 4, 1924).

* * *

How Canadian Government Surveyors Turned a Clever Trick

MEMBERS of the Geodetic Survey of Canada, part of whose work is to make accurate maps of new country, found that when they began a survey of the Canadian Rockies they had no place level enough to measure off a base-line, so they sat down and waited for winter to come and freeze over a small lake and then measured their line as accurately on the ice as they might have done on the sand of a long beach.

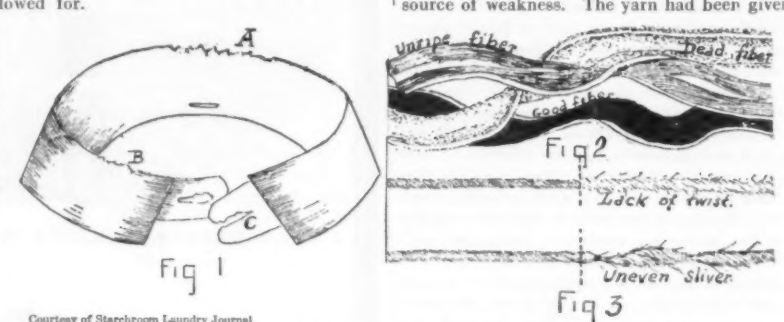
The accurate measurement of a fairly level baseline always forms the beginning of such a survey and the accuracy of the whole survey depends on the precision of measurement of this one line. In a distance of three and one-half miles, even an error of a quarter of an inch would be regarded as too large.

If you were making a map of a mountainous section of country you would find it impossible to take accurate tapeline measurements from peak to peak because the country is so rough. The way this is done by precise surveyors does not require this slow method, however. A surveyor's transit and a little knowledge of mathematics makes it possible to determine the distances very accurately from point to point even though these points are separated by several miles of rough mountainous country. This is done by means of what is called a triangulation, and the beginning of every triangulation must be one, single, carefully tape-measured line. After that the work is comparatively simple.

The baseline forms one of the three sides of a triangle, the other two sides being lines reaching from the ends of the baseline to some distant point. The transit measures the three angles of the triangle, and the two unmeasured sides can be calculated by trigonometry from this date. Now that you have found the length of the other two sides of your triangle, one of them serves as the transferred base line of a second triangle, and so on through triangle after triangle. In this manner it is possible to survey a very large

area, simply by covering it with a network of triangles, all of whose dimensions were derived indirectly from the length of the baseline which formed one side of the first triangle laid out.

The baseline measured on the ice of the Canadian lake was exactly 5,800 meters long, and posts were held in holes cut in the ice every fifty meters until the water poured around them froze them in. The tapes used for such important work are not the ordinary tape, but are made with extreme accuracy and must be used with great skill if small errors are not to be made. They have a special thermometer attached, by means of which the temperature may be known at the time of each measurement and the amount of contraction of the tape due to the cold allowed for.



Courtesy of Starchroom Laundry Journal

Put collars that get "saw-edged" under the microscope

Unfortunately for the rapid progress of the work, but fortunately for the comfort of the surveyors, the thermometer supplied with the tape used by the Canadian experts did not read lower than two degrees below zero, while the temperature of the air was often thirty degrees colder.

Even at temperatures around zero the party did not greatly enjoy the very delicate work of measuring the baseline, especially during the winter storms that came down from the mountains. — *Canadian Engineer* (Toronto. Ontario, Canada), vol. 47, page 318, Sept. 9, 1924.

* * *

Kinks That Keep Your Collars From Wearing Out

THE rapid wearing out of your collars may occur largely in the laundry but it is not usually the fault of the laundry. It may often be traced to the cotton mill in which the cotton fibers were spun into yarn. It needs a microscope, magnifying a few hundred diameters, to reveal the full cause of the trouble.

Pull from some garment or from a piece of cotton twine or cotton cloth a tiny bit of cotton yarn, hold it to the light and separate out one single fiber. This fiber will probably be less than an inch in length. Even with the naked eye it can be noted that it is not a comparatively straight shaft like a silk fiber.

Put this fiber under the microscope and you will see that it appears to be twisted or kinky, resembling a piece of twisted-strip Christmas candy. When several short cotton fibers are twisted together the little kinks of the fibers interlock. This is what enables us to make a strong thread out of fibers less than an inch in length. If silk fibers with their straight shafts were as short as cotton fibers we could not make thread of them at all. They would not lock together.

Under the microscope some cotton fabrics reveal the presence, among the good fibers, of a certain proportion of "dead" fibers and possibly of some "unripe" fibers. The dead fibers look puffy at the edges and their walls are irregular. Such fibers cannot be spun into firm, elastic and even yarns. They interfere with the spinning processes so that weak threads result. Cotton cloth into which threads containing dead fibers have been woven makes collars that crumble easily, even with plain hand washing.

The other class of objectionable cotton fibers, the unripe ones, are obtained from cotton plants the seed of which has not matured. Such fibers are weak, they split easily and do not spin well.

The cloth of some collars contains both dead and unripe fibers. Good collars contain few of either. If we are to choose a good brand of collars to stick to we must become a microscopist, get a collar of each kind, dissect them and see what their fibers are like.

There is another reason why collars become bad. If the yarn from which the goods is woven is not twisted enough or if it is not twisted uniformly, the yarn will not be strong. Collars made of it will go to pieces very soon, whether sent to a power laundry or washed and laundered by hand.

In figures 2 and 3 the lefthand ends of the yarns are correctly woven. The right ends are incorrectly woven. Figure 3 is so loosely twisted that the little kinks in the short cotton fibers do not interlock strongly. Such yarn is weak at all points. Figure 3 shows another source of weakness. The yarn had been given enough twist as a whole, but the twisting has come mostly in spots. The yarn is lumpy. The places between the well-twisted spots are weak.

An easy way to duplicate this condition in an experiment is to take a small amount of absorbent cotton and spin a yarn from it by hand. Moisten the fingers, seize a protruding tuft of fiber and twist it, at the same time pulling it out. In this manner, with about a minute's practice you can learn to spin a yarn of several feet length, but you cannot hope to spin it evenly. In places your yarn will be very strong, while other places which did not receive enough twist will be very much weaker.

Now you have almost duplicated some of the causes for the early decrepitude which irk you so. The laundry is willing to accept some of the responsibility—the best of washing destroys collars to some extent. But it pays to buy collars made of good material. —*The Starchroom Laundry Journal* (Cincinnati, Ohio), vol. 31, pages 37-38 (September 15, 1924).

* * *

The Ice-Cream-Freezer System for Shipping Fruits

IF salt were added to the ice that is used to keep fruits and vegetables cool in refrigerator cars, people living in inland communities could enjoy such delicate tropical fruits as figs, mangoes and nectarines.

Most refrigerator cars are cooled to various temperatures between forty and fifty degrees, Fahrenheit. They are seldom as cool as thirty degrees. Yet it has been found that a few degrees difference in temperature makes a decided difference in the condition of the perishable fruit. If the car in which melons are shipped on an eleven-day journey is not maintained at a temperature below fifty degrees about eighty percent of the melons may arrive soft. Lower the temperature of the car to about forty degrees—only a few degrees change—and about ninety percent instead of ten percent of the same melons should arrive at the end of the same journey in good condition with no sign of rot.

Within certain limits salt added to ice produces a brine the temperature of which falls below the freezing point in proportion as the salt is used. In 1714 Fahrenheit added ammonium chloride to snow and produced what he believed to be the lowest possible temperature. He called it zero. Ammonium chloride, like sodium chloride, is a salt. Sodium chloride or common salt produces much the same effect, as is well known to any one who has cranked the ice-cream freezer and kept it filled with ice and salt.

In shipping meats it has for some time been the practice to add salt to the ice contained in the ends of the refrigerator car. When, however, it came to using salt with ice to cool vegetables and fruits, shippers refused. They feared that these delicate commodities would themselves be frozen and ruined.

The newer method consists of adding about five percent of salt to the ice at the initial icing of the car. After the car has traveled a day or two about one percent more salt is added. In this way the temperatures may be kept down to about thirty-five degrees on the journey and the fruit saved.

Fruits and vegetables do not freeze at thirty-two degrees. The solids contained in solution in the juices inside the fruit reduce the freezing point to a considerable extent. For instance, apples, plums, blackberries, potatoes and grapefruit do not freeze until the temperature is down to about twenty-eight and one-half degrees. Even oranges withstand a temperature of four degrees below the freezing point of water. Most other raw fruits come within these ranges.

Thus the cars in which such products are shipped may quite safely be iced and salted enough to keep them below forty degrees.—*Railway Age* (New York), vol. 77, pages 947-950 (Nov. 22, 1924).

* * *

The Gas Turbine—Is There Anything in It?

"No," says Professor Lionel Marks of the department of mechanical engineering of Harvard University. "It offers no possibility of increased efficiency."

"Yes," says Dr. Lowenstein of the General Electric Company. "Its possibilities are attractive."

Whatever the ultimate outcome of the gas turbine, engineers are discussing it. Research is being done in the hope that this interesting source of power can be brought to a high enough degree of efficiency to compete with the steam turbine and with that close running mate of the steam turbine, the Diesel crude oil engine.

and fuel flow into the combustion chamber steadily, and thus the gases formed impinge steadily on the buckets of the turbine rotor. This is more like the steam turbine, and it is called the constant-pressure-combustion gas turbine.

With both types the greatest problem yet to be solved is that of temperature. We want to employ as high a temperature as we can because in that way we can get the most power out of the fuel. Unfortunately the high degree of heat which we would need to use in the gas turbine in order to get as much power out of our fuel as the steam turbine and the Diesel engine now get out of their fuel would overheat and ruin the parts of the gas turbine itself. Are we then at the end of our rope? Engineers disagree.

Practically all steels lose half their tensile strength even at 1,000 degrees, Fahrenheit. The hot gases of the gas turbine soon ruin the blades or buckets of the rotor against which they impinge. First the surface layer of the metal oxidizes; then it is literally washed away by the swift flow of hot gases.

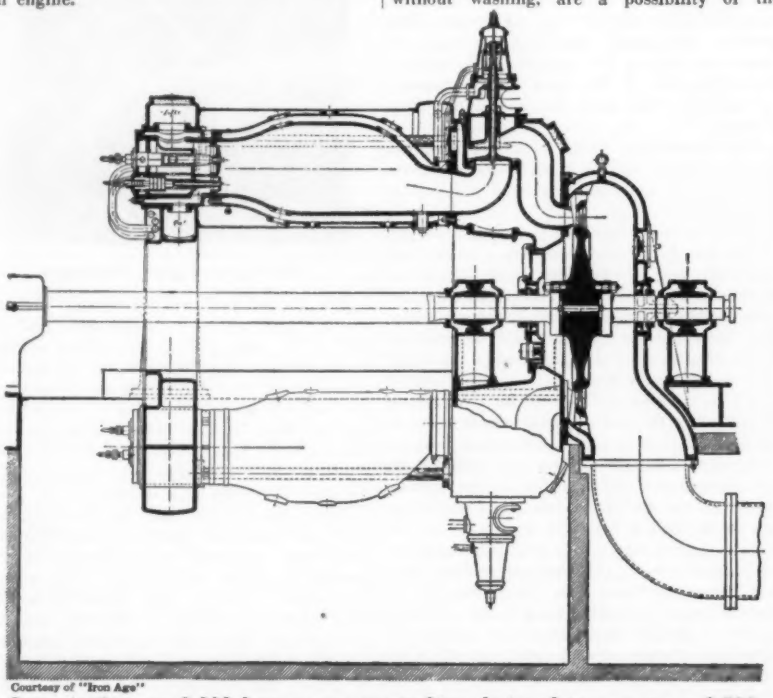
Dr. Lowenstein believes that he has solved this difficulty. He uses buckets made of fused quartz. Quartz is able to withstand much more heat than steel. Some doubt whether quartz is strong enough to stand the wear and tear but Dr. Lowenstein believes that it is.

The suggestion of Dr. Lowenstein is to link the gas turbine up with the Diesel engine. The exhaust gases of the Diesel engine, instead of being thrown away into the air, would then be run through the gas turbine. In this manner a great deal of energy that is now being wasted would be captured.—*Power* (New York) vol. 60, pages 935-936; *English Mechanics* (London) vol. 120; one page; *Iron Age* (New York) vol. 114, pages 1329-1333 and 1407-1409 (November 20 and 27, 1924).

* * *

Why Wash Your Dishes? Eat Them

DISHES that will be used but once and which will be thrown away after each meal, without washing, are a possibility of the



Courtesy of "Iron Age"

Cross section, an 8,000 horsepower gas turbine designed to operate at 1,500 revolutions per minute

The gas turbine is not merely a theory. Gas turbines developing thousands of horsepower are in actual use, especially in Germany. There are two kinds of them.

In one kind the compressed air and the fuel oil are introduced into a combustion chamber through a valve. The valve is closed, the mixture is ignited and exploded, and the gases impinge on the rotor and make it revolve. This is the explosion turbine and it is obvious that it has much in common with the ordinary internal combustion engine.

In the other kind of gas turbine the air

future suggested by Dr. Willis R. Whitney, Director of the Research Laboratory of the General Electric Company in a recent interview in the New York World.

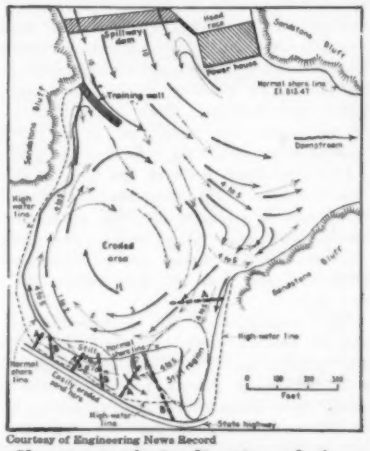
This is a problem which is unlikely to occur to most of us—perhaps because we are too close to it. People have always washed dishes. We let it go at that and go on assuming that people always will. Yet, in all the world's work of dishwashing a staggering amount of human energy is consumed.

Why not find a way, says Dr. Whitney, to have new, clean dishes every time we eat?

Such dishes might be made, he suggests, of the phosphate rock of Iowa reduced in electric furnaces to something corresponding to citrate soluble-phosphate, ground to powder, mixed with some simple binder and pressed into attractive plates by machinery.

When used once, these plates would go with the garbage to the farm. There the phosphate of the plate, spread on the land, would slowly dissolve and act as a fertilizer.

In this way one might be said to be the eater of one's own plate, for the next year's crop of farm produce, or possibly that of the year following would take from the soil essential plant foods which had been put there when the broken shards of the temporary dishes dissolved and gave up their phosphates.



Courtesy of Engineering News Record

Changes made in direction of river flow by a small wall. Dotted arrows show current before training wall was constructed. Heavy arrows show current as changed by the wall

Breaking the Will of a Stubborn River

WHEN it was seen that the flood flow of the Kilbourn River, in Wisconsin, was seriously threatening to undermine a highway just below a power dam owned by the Southern Wisconsin Power Co., (Kilbourn, Wisconsin) a miniature model of the river and dam was built at the hydraulic laboratory of the University of Wisconsin for the purpose of studying how best to control the flood waters.

This interesting model, faithfully reproducing the dam, the power-house and the river channel, was built on a scale of one foot to one hundred.

Just below the dam, the river bends sharply to the left, but it had been very rapidly wearing away the river bank at the outside of the turn opposite the dam. The pocket thus begun facilitated the formation of an eddy, and this increased the erosion until the eddying basin finally covered eight acres. To break up this current a wall was suggested, extending into the river. This was for the purpose of swinging the river current where it ought to go. But it was realized that mere advance judgment might not determine rightly the size, length and exact location of this training wall. So the model was built, and water was let in through a four-inch pipe with an accurate gaging meter to permit simulation of all stages of flood. The water that flows from the power turbines, was represented by a one-inch pipe controlled by a meter. A third device controlled the down-stream water level. One-foot squares were painted in white on the bottom of the model, so that the exact direction of flow of the water under all kinds of conditions could be determined. Sawdust was used on top and under the water, to enable the flow to be followed, while the rate of travel of the water was timed from floats, by a stopwatch.

The advantage of making these preliminary tests was demonstrated after the training wall decided upon from the model was actually built in the river. Had the training wall been built up above the high or flood-water level, as one would naturally think most desirable, there would have been serious whirling in the pool below it, with consequent undesired erosion.—*Engineering News-Record* (New York), vol. 93, pages 429-430 (Sept. 11, 1924).

One Pipe 180 Miles Long

MOST of the pipelines through which oil is pumped across country from the oil fields are now being welded instead of connected by means of threaded connections. This method not only does away entirely with the bother and cost of threading pipe, but it practically eliminates leaks and makes one continuous tube out of a large number of lengths of pipe.

The welding is done by means of the oxy-acetylene torch and the work proceeds so rapidly that two miles of pipe having a diameter of eight inches may be welded into one piece in a single working day.

A line of this nature was recently laid from the village of Luling in the oil fields of Texas to Hull, 180 miles east. This piece of work, which was done by the Magnolia Petroleum Company, assisted by the Linde Air Products Company, required but one hundred working days from the very beginning of operations to the actual use of the pipeline for pumping oil. This is the longest welded pipeline ever undertaken.

After the right-of-way along which the line was to be laid had been cleared of brush and other obstructions the lengths of pipe were strung along the line and were lined up ready for welding.

The welders next welded the short lengths of pipe into single units each of which was made up of from five to twenty lengths. These units were then connected on the line. Right behind the gang that did this work came another gang who made the necessary bends in the pipe and put in the slack necessary to compensate for the contraction and expansion of the line owing to changes in temperature.

About a mile behind this gang came the painting gang who painted the pipe, then the ditching gang who pushed it into a ditch dug close beside it.

Courtesy Linde Air Products

Making one pipe from two

The hardest problem was to take the line across several rivers, especially since this task had to be done during the season of high water. It was done in the following manner: A five-length unit was made up by welding, its end was plugged so that it would float, and as each section was hauled into the water another length was welded to it. The growing section of pipe was hauled across the river by means of a windlass.

When ninety-three miles of the long line had been completely welded it was filled with water and subjected to a pressure of 740 pounds per square inch. In the entire ninety-three miles only one bad welded joint and three pinholes were found. The line ought to be regarded, not as fifty thousand connected lengths of pipe, but as a single, 180-mile piece of pipe.—*Oxy-Acetylene Tips* (New York), vol. 3, pages 46-52 (October, 1924).

* * *

The Stuff a Man is Made of

DOCTOR Charles H. Mayo, the famous Rochester, Minnesota, surgeon, states that the average man's body would furnish fat enough to make seven bars of soap; iron enough for a medium sized nail; sugar enough to fill a salt shaker; lime enough to whitewash a chicken coop; phosphorous enough to make the tips of 2,200 matches; magnesium enough for a dose of magnesia; potassium enough to explode a toy cannon; and sulphur enough to rid a dog of fleas. Value, said to be about ninety-nine cents.

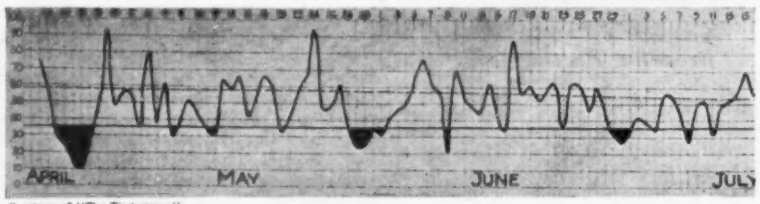
Predicting Forest Fires

By keeping close watch of the instrument known as the hygrometer, which indicates the percentage of relative humidity of the atmosphere, the foresters of the states of Oregon and Washington are now able to predict when forest fires are most likely to occur.

A comparison between the Weather Bureau's records of relative humidity of the air and the records of past forest fires at once makes clear an interesting fact: The forest fires have nearly all begun during those rare spells when the relative humidity of the air was below thirty-five percent with the thermometer at the same time standing above sixty degrees, Fahrenheit.

An inspection of the accompanying chart where the black areas indicate such weather shows clearly how small a percentage of the time such a combination of weather conditions occur. These are the times when the foresters and fire wardens have learned that it is wise to expect trouble.

When the hygrometer begins to creep down toward the thirty-five percent moisture mark warnings are sent out to the lumber camps in the forests that extreme care must be taken to avoid the accidental starting of any kind of fires.



Courtesy of "The Timberman"

When the humidity curve falls below the straight black line, look out for forest fires!

Ordinarily, when a human being says it is a dry day he only means it is not a wet day. The hygrometer, however, tells much more about the amount of moisture in the air than a human being can tell. Even on a rainless day it tells just exactly how much relative moisture or humidity there is in the air.

When the air has taken up as much moisture as it can possibly hold it is said to be saturated, and the relative hygrometer reads 100 percent. If, on the other hand, the air were absolutely devoid of any moisture the hygrometer should read zero percent. Such extremes hardly ever occur. The air always contains some moisture.

Provided there were no rain falling, would you not assume that a fire would burn as briskly on one day as on another? Forest fires do not. They appear to thrive on very dry weather, and the reason is that at such times the dampness that is in the fibers of the underbrush, leaves and pine needles creeps to their surfaces and is evaporated, leaving the insides of these things bone dry. Then, when the flames start they have little or no moisture to fry out of the underbrush and deadwood. Thus, they burn this matter up much faster. This is simply another way of saying the forest fire seems to spread more rapidly than usual.

Out in the forests of Oregon and Washington they have learned that weather of the sort that breeds uncontrollable fires can be predicted a day or two ahead. In fact, so clearly were they able to prove this to the United States Weather Bureau that two government meteorologists have been assigned to the interesting work of keeping an eye on the peculiarities of the winds that seem to bring the fire-aiding combination of warmth and extreme dryness to that locality. These scientists have already been able to save immense fire losses by warning the lumber camps in the mountains when to redouble their watchfulness against the kind of carelessness that starts little fires which grow big.

In getting away from mere weather guesswork and putting forest protection on a basis of science some peculiar facts were soon made apparent. One was that even a long spell of ordinary rainless weather was not as bad a fire risk as a single day of the bone-dry-warm kind.

The fire records of the Washington Forest Fire Association show clearly that during the season of 1924 three fourths of all the forest fires began on bone-dry-warm days. Further, they show that ninety-five percent of the total fire damage occurred in forest fires which started in such weather, clearly showing that the fires that start at these times are much more difficult to control than those which start in ordinary weather.

It is now proposed to equip every lumber camp with a hygrometer so that the arrival of dangerously dry days may be known to those who are too far isolated to receive the warnings of the Weather Bureau. It is suggested that such an instrument be arranged with an electric bell and battery in such a manner that the bell will automatically ring when the air approaches the risky point of dryness.—*The Timberman* (Portland, Oregon), vol. 26, pages 65-70, November, 1924.

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Food and the Migration of Fishes

The migration of fishes, long a matter of much commercial and scientific importance, received light from a new angle in discussions before the recent meeting of the British Association for the Advancement of Science by Professor A. G. Huntsman, of the University of Toronto.

Professor Huntsman studied, not the fishes themselves, but the host of minute plants and animals, called the plankton, that constitute their chief food. Influences that control the movements of the plankton must also control to a large extent the movements of the fish that feed on them. Professor Huntsman has found that the organisms in the plankton respond in the main to three sets of influences: light, temperature and degree of saltiness or salinity. Light does not penetrate into water to any great depth; below a few hundred feet the world of the waters is perpetually dark. Some of the animals in the plankton like the dark and dive toward the bottom during the day, while others like the light and luxuriate on the surface during the sunny hours. They are similarly affected by differences in temperature, being distributed both in depth and latitude according to the prevailing temperature of the water. Finally, salinity affects them. The ocean is not equally salty everywhere, but has more salt in quiet waters that receive few rivers, especially in tropic latitudes, where evaporation rates are high, like the Mediterranean and Red Sea, and less salt in regions where much fresh water or ice comes in and there is little evaporation, as in the Arctic Ocean.

It is the influence of such conditions as these that makes for differences in the amount and distribution of the plankton and hence on the movements of fishes. Ocean currents complicate the situation by mixing up waters of different temperatures and salinities. Warm waters, like the Gulf Stream and Japan Current, profoundly affect the cold-water life of the northern oceans, while cold waters of low salinity, like the Labrador Current, reverse conditions in the warmer southern areas.—Abstract from *Science*, Aug. 18, 1924.

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The Growth and Feeding of Honey-bee Larvæ

A recent Bulletin of the U. S. Department of Agriculture is a report on the study of the growth and feeding of honey-bee larvæ. One part of the report is devoted to the problem of growth. Larval development, up to the time of the sealing of the cell, lasts four and one-half to five and one-half days. From various observations it was found that the change in the composition of the larval food from one of high nitrogenous content to one of high sugar content takes place as early as the third day after hatching from the egg—this differs from the well-known statement of

Von Planta in which the change is mentioned as occurring on the fourth day.

There has been much controversy as to whether the food of the young larva is a secretion from glands or a regurgitation from the ventriculus. Its consistent lack of pollen grains and uniform appearance suggest secretion rather than regurgitation. The growth of the worker larva is remarkably rapid, and within four and one-half to five days it increases its initial weight by more than 1,500 times, the most rapid increase taking place during the period when it receives the nitrogenous diet.

The second part of the Bulletin deals with the feeding of the larvæ. It is found that the elaborated food upon which the larvæ feed during about the first two days of their life is practically all placed with the newly hatched larva soon after hatching. Soon after the second day, food containing undigested pollen is given at about the same rate as it can be consumed.

It is suggested that, owing to the fact that the nurses devote an excessive amount of time to the older larvæ as compared with the younger, possibly reciprocal feeding is involved. This latter phenomenon is very evident among ants and wasps, but has not so far been observed among bees.

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Breaking Up the Atom

IN an address given at the Centenary of the Franklin Institute Sir Ernest Rutherford presented results recently obtained in studying the structure of the atom. Sir Ernest showed how he has been able to smash up the atoms of many elements by bombarding them with powerful particles projected from radium atoms as these break up spontaneously.

The projectiles are known as alpha particles and weigh about four times as much as an atom of hydrogen, the lightest of elements. They carry a double charge of positive electricity, but whenever they can steal two negative electrons from the atoms that they drive through in their swift flight they settle down into inert atoms of helium gas, a very different element from the heavy metal radium which gave them birth.

By means of a new and more delicate apparatus Professor Rutherford has succeeded in disintegrating the atoms of many of the natural elements, namely nitrogen, aluminum, sodium, potassium, boron, phosphorus, fluorine, magnesium, silicon, sulphur, chlorine and argon.

But some of the elements, notably oxygen, have so far stubbornly resisted his best efforts to break into the nucleus of their atoms. This exceptional stability may account for the fact that oxygen forms half of the substance of the rocks, air and water taken together.

When the elements are arranged in the order of their atomic weights and numbered from hydrogen, the lightest, to uranium, the heaviest, it is found that the even numbered elements form eighty-six percent of the earth's crust.

Oxygen is one of the even numbered elements and its nucleus is supposed to contain four alpha particles each made up of four hydrogen nuclei, forming a strong and stable structure.

* * *

Electricity is Ousting Steam and Gasoline for Drilling and Pumping Oil Wells

OIL well drilling and pumping which has been done by steam for several decades is now being done very largely by electricity. Many oil wells that could no longer be pumped at a profit by engine drive have been changed to electric motor drive, and are still being pumped at a profit.

Recent investigations show that the cost of electric power for oil well pumping is considerably lower than the cost of doing the same work by steam or by gas engine. The State Bureau of Mines of California predicts that "the time is not far distant when all operations in the proven oil fields will be carried on by means of electric power."

Electric motors were used in connection with oil wells only for pumping, but now the well drilling is also being done by electricity. The electric motor drives the same belt that was formerly driven by a steam engine. This belt in turn drives the drilling tools.

The chief advantage gained by the substitution of electricity for steam is lowered cost. For instance, the Pinal Dome Oil Company, of California, gives a cost comparison between three deep oil wells, one of which was drilled by an electric motor, one by a gasoline engine, and a third by a steam engine.

Each foot drilled cost for power as follows: By electric motor, eighty-two cents; by gasoline engine, eighty-five cents; by steam engine, two dollars forty-nine cents.

Many of the oil fields, especially of California, are now traversed by high tension electric transmission lines, and electricity became a success in this work because improvements made to electric motors and their controls within recent years have made them more flexible for drilling purposes.—*Journal of Electricity* (New York), vol. 53, pages 195-198, Sept. 15, 1924.

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Putting Our Ships Away in Mothballs

ARE the laid-up Shipping Board ships which swing peacefully at anchor in a score of our harbors being kept up well?

In March, 1923, nine hundred of these ships were brought together into compact fleets, some of which are so large as to resemble fair-sized islands. In January of 1924 the care of the laid-up ships was assigned to the Ship Sales Department of the Fleet Corporation. Several ships were immediately placed in drydock so that their bottom plating could be inspected. In each case this was found to be in good condition.

The next work was to protect the machinery of the ships from rust and corrosion. Engines, turbines and boilers were opened up and all their surfaces were coated with grease. The cylinder heads and upper turbine castings were raised, supported on sleeve bolts and left constantly open for inspection. The boilers are now being cleaned and scaled and painted inside and outside.

To perform this work one of the vessels was fitted up with all the necessary cleaning, scaling and paint-spraying apparatus and with quarters for the workmen. Two ships are being reconditioned at one time, one on either side of this workship.

The crew that is doing this work consists of forty mechanics and 175 laborers. At the present rate of progress twenty large vessels can thus be reconditioned per year at a cost per ship of only about $17,000.—*Marine Engineering and Shipping Age* (New York), vol. 29, pages 654-656, November, 1924.

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New Facts Concerning Color-Blindness

DR. F. M. BALDWIN, professor of physiology at Iowa State College, after a series of experiments on color-blindness in the human eye, has found that one portion of the eye of an individual may be color-blind while another portion is not. In one eye there may be a spot on the retina, capable of distinguishing certain colors and in the opposite eye of the same individual the corresponding spot not able to distinguish colors.

The variations are caused by the variation in distribution of the photo-chemical substances in the retina. An engineer might be able to pass a railroad test for color-blindness and yet the range of his eye in distinguishing colors may still be limited to the exact focal point of the eye. An engineer with such a limited range of color distinction would be a dangerous man to have at the throttle of an engine, according to Dr. Baldwin, because the great speed of the train and the variation in light, both make it possible for him to fail to read his signals properly.

Near-sighted persons have a larger field of color discrimination than far-sighted people. According to all creditable data, color-blindness is more prevalent among men than women. Approximately five percent of all males are unable to distinguish more than two colors, while only about one percent of females have this defect.

Learning to Use Our Wings

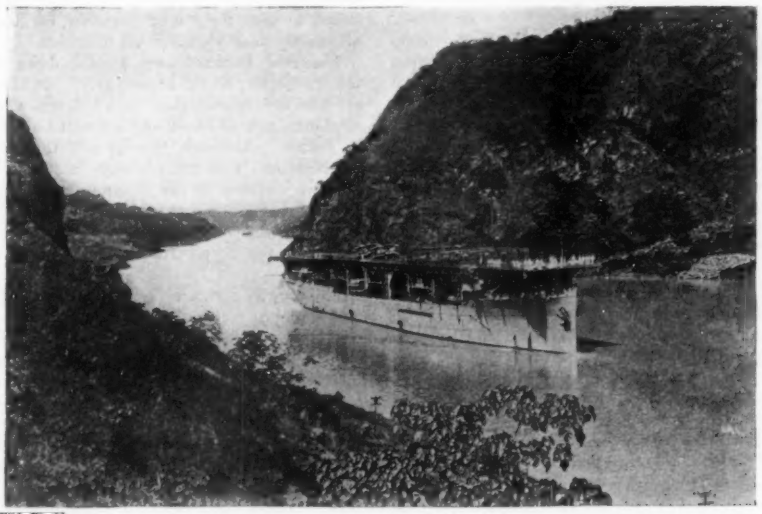
Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin
Associate Professor of Aeronautics, New York University

Catapulting and Receiving

TO the captain of a battleship at sea, a scouting airplane is of little use if it has to be laboriously launched overboard perhaps in a rough sea. Hence as early as 1912, the United States Navy gave serious consideration to the launching of planes from ship deck by application of the catapult. Commander H. C. Richardson, in a paper before the Society of Automotive Engineers' traces the development of this device and its present remarkable practicability.

The deck of a battleship is encumbered with masts, gun turrets, funnels and other paraphernalia, hence the catapult must be small so as not to encroach on fighting space. To minimize difficulties of piloting in a cross wind, it must be capable of swinging into the wind, and is, therefore, mounted on a turntable. The minimum flying speed of a navy plane averages 50 miles an hour, therefore, a tremendous acceleration must be provided to secure this speed in a short run. Catapult turntables meeting these requirements have now been installed on twenty-five or thirty war vessels.



Wide World
The U. S. S. Langley, the Navy's airplane carrier, which was developed to meet the problem of receiving planes

The catapult turns about its center. The airplane is mounted on a launching car, to which it is held fast to prevent nosing over while the engine is being warmed up and to resist the effects of possible heavy rolling. The launching car is propelled by a simple, compressed-air engine, with suitably charged air flasks to provide its motive power. When everything is ready and the pilot gives a signal, the air valve is thrown open and car and plane proceed down the inclined track, until the car hits an arresting device and the plane forges ahead sustained henceforth by the pull of its propeller and the lift of its wings.

To get the speed of 50 miles an hour, in a run of less than 50 feet, a force of roughly two and a half times the weight of the airplane must be applied to it, and a pretty engineering problem has to be met in making the float and its bracing carry the enormous concentrated load. The latest Navy catapult, details of which are still a secret, is propelled by a powder charge instead of compressed air, with gain in both simplicity and effectiveness.

The Navy is perfectly satisfied with its catapults. The problem of receiving airplanes is a more difficult one. Airplane carriers such as the Langley have been developed to meet this problem, with long decks free of all obstructions, of great width and with elaborate arresting devices of cables and weights. While these carriers are rendering splendid service, they are slow and practically defenseless in action, and they cannot always head exactly into the wind, so that pilots sometimes go overboard with a nasty ducking as their reward. An interesting invention is described in *Aviation*, for which it is claimed that it will make every battleship its own aircraft carrier.

This is the Gibbons Landing and Launching device, invented by a well-known Brooklyn builder. Briefly the device consists of a flat unobstructed platform, pivoted longitudinally at its center, mounted on a circular track and manoeuvrable in tilt and turn by electric power. The platform can thus be headed into the wind either for landing or for launching, can be made to offer a downward inclined surface with gravity accelerating the airplane, or an upward inclined surface for retarding the aviator. Transversely stretched steel cables also help to retard the plane on landing. But the greatest novelty of the device is in the disposition of a grid on the platform through which the air is drawn down by means of large ventilating fans.

When a plane approaches the ground the air under its wings is banked up and there is a tendency for the airplane to "float" instead of settling when required by the pilot. This bank of air the grid and fans remove effectively. The net result, as calculations, model and wind-tunnel work have shown, is that a plane of average size can be launched on a platform not more than 175 feet in length and effectively arrested within the same distance.

Owing to the comparatively small size of platform required the inventor suggests that the device could be installed on any battleship or cruiser over 10,000 tons, on great ocean liners for receiving late mail after leaving port, on city dock piers and even on large buildings, thus bringing the airdrome to the very heart of a city.

"Blue-Books" for Airplane Travel

WHEN Elmer Davis, the well-known sports writer, was asked by *Collier's Weekly* to see how the Army Air Service was faring, he traveled three thousand miles

by air, and found it safer than traveling three thousand miles by automobile. The Air Service, in preparation for an emergency where it might have to move great numbers of planes to the Mexican border, for example, has charted many air routes across the country, with landing fields and repair hangars strewn at intervals along such routes.

The Aeronautical Bulletin, published by the Army Air Service, contains the sort of information that automobile clubs have gathered about land roads in the last twenty years. From these bulletins strip maps have been prepared which the pilot revolves on a drum in his cockpit. The following are remarks on a characteristic strip for the beginning of the airway from Kansas City to Wichita, Kansas:

Course, 329° 40′ True;
Magnetic Declination 10° East.

Mileage	
0	Leaving Richards Field, 15 miles southeast of city, best emergency fields after take-off are east and south.
1½	Pick up red-roofed country club buildings with white water tower and pass one quarter mile north;
4	pass over auto race track, noting white concrete tower 2 miles north, crossing several railroads converging into city.
20	Open stretch of ground, follows course to Olathe, Kansas. Best landing field very poor, located in curve of Santa Fe track at southwest corner of town 2 miles from center. . . .

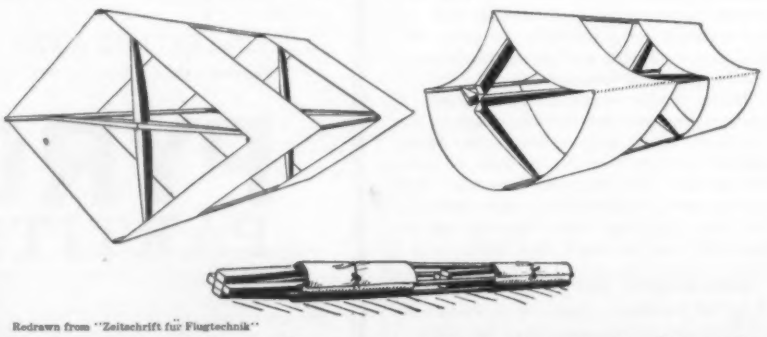
Man-Carrying Kites

THE Chinese General Han Sin knew kites in the year 200 B.C. and the youth of every nation have flown kites ever since. It was only toward the end of the 19th Century, however, that attempts were made to employ man-carrying kites in the German Army for military observation purposes. The kites could not at that time be made serviceable, because little was known of aerodynamics and stability, and the breakage of the holding down cable generally meant death for the operator. When the submarine campaign was at its height and German U-boats were perishing almost daily, a strenuous effort was again made to evolve a man-carrying kite, which could be stowed on board and increase the range of the look-out a hundred fold. The secret experiments made at that time are now described for the first time in the *Zeitschrift für Flugtechnik*.

A kite must be capable of sustaining its own weight and that of its passenger in a very low wind and hence its supporting surface must be enormous. A submarine on the other hand is crowded with machinery and other equipment and has little space left over. The Germans met these conflicting requirements in very clever fashion. The box kite used by them consisted of two wooden crosses at front and rear, forming a rhombus, with four wooden beams or spars connecting corresponding points at either end. Over this was stretched the fabric. By a simple mechanical release the crosses were made collapsible, and the whole kite disappeared into a small, neat package not unlike a rolled umbrella. The drawings on this page show such a kite partly open as well as open and ready for use. The lower drawing shows the kite folded and ready for carrying. In operation the kite was launched first, the basket with its occupant was hauled up by a man-power winch afterwards, and the lookout could regulate his position on the cable by a system of pulleys and brakes. This did not yet solve the problem of what happened to the man when the holding cable broke, the submarine suddenly turned or the wind fell. A peculiar form of kite has been evolved in which the man sits within the kite itself, on a keel-like structure extending its whole length. If his weight is suitably disposed forward, breakage of the cable transforms the kite into a glider descending safely groundwards.

The kite in this later form still weighs two hundred pounds or so, its surface is large and the cable correspondingly strong. The ingenious Germans have now invented a parachute-kite, in which the supporting mechanism is just like that of a parachute, but with cable connections so arranged, that the wind strikes it obliquely and the usual air lift or sustention is produced. When the wind ceases the operator comes down harmlessly to earth, with his body forming the bob of the pendulum. Such a parachute-kite weighs only 40 pounds, and is of the simplest and most inexpensive form.

The Germans, also fond of hiking with a "Rucksack," apparently consider it a fascinating new sport to pack such a kite and to wander off for a little aerial acrobatics. Perhaps we shall see a couple of American high-school boys imitating this latest form of amusement, which reduces flying to a minimum of trouble and expense.



Redrawn from "Zeitschrift für Flugtechnik"

The upper figure at the left shows the new German man-carrying kite ready for flight. Below it is folded for carrying

Air Taxis

COLONEL H. E. Hartney, former commander of the First Pursuit Squadron of the A. E. F., with a distinguished record as a fighting pilot, announces in the *New York Times* the formation of a Yellow Air Cab Company, to operate nine planes in Chicago and three planes in each of four other large cities. The plane to be used is painted the color of the well-known Yellow Taxicab. With a 90-horsepower, 10-cylinder air-cooled Anzani motor, it can carry a pilot and four passengers in a comfortably enclosed cabin and can cruise at 80 miles an hour with a mileage of 16 to the gallon of gas. Is this a dream or a sound business proposition?

The commercial airplane has long ago passed the stage of prohibitive luxury and such a plane is undoubtedly economical. The prospect of offering a business man in Detroit a two and a half hour ride to Dayton at any time he may choose, instead of a train journey consuming the whole day or a tiresome sleeper ride, is fascinating.

What are the factors against the success of the gallant colonel's scheme? Rapid depreciation of plane and motor; an insurance rate of at least 20 percent per annum; unreliability of service in foggy or stormy weather; loss of time at either end of the journey in getting to and from the airdrome, which cannot be in the heart of the city like a railway station; unfamiliarity and only partial confidence on the part of the public. At any rate the experiment, which is soundly backed, will be well worth watching.

Super Seaplanes

CAPTAIN Gherardi in his recent report to Secretary of the Navy Wilbur stressed the strategic importance of large, seaworthy flying boats, of tremendous range and capable of working far ahead of the fleet, independently of support by surface vessels. Such types of seaplanes would be particularly useful in the Pacific, where, conceivably, a rapid defense of our island possessions might have to be made long before the Pacific fleet itself could reach the scene of action. The Navy has taken the first step in this direction by placing an order for a giant super seaplane with the Boeing Airplane Company of Seattle, Washington, very appropriately located on the Pacific.

Fully loaded the seaplane weighs 2,400 pounds. It has a stretch of wing of 87 feet 6 inches, a chord or width of wing of 14 feet, and a total area in its biplane wings of 2,400 square feet. The hull, approximately 60 feet in length, built entirely of duralumin, avoids the deleterious soakage of a wooden hull and is seaworthy enough to keep afloat in the roughest sea. Two Packard motors—the largest aero engines ever built in the United States—of 800 horsepower each—furnish the motive power. For an airplane engine to deliver a maximum power for a given weight, it must have a large speed of revolution; the Packards actually turn up 2,200 revolutions per minute. In a comparatively slow airplane on the other hand the propellers should not revolve too fast, or else their moderate forward speed will not bear a sufficient ratio to the enormous rotational tip speed of the blades. In many a design of large bombers and seaplanes, propellers have failed to give their best efficiency for lack of engine and propeller coordination.

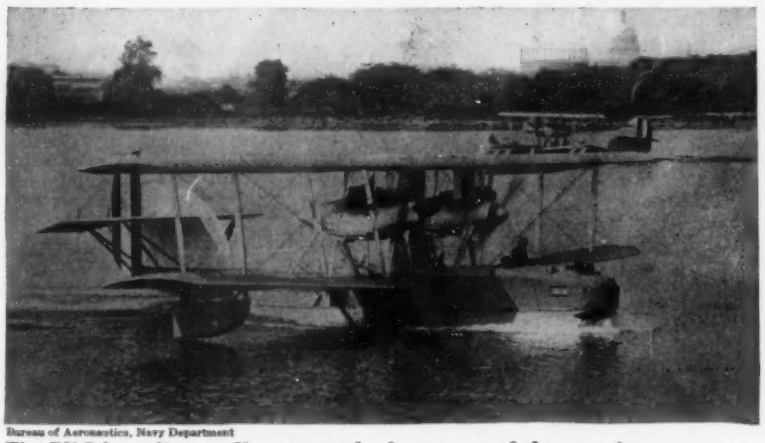
The new Packards are geared down in the propeller drive accordingly. In fact experts are agreed that in all large, slow airplanes, geared down engines will be used in future. Although this is not the best combination from an efficiency standpoint, the two engines in the Boeing flying boat are placed in tandem, with one propeller ahead of the combination, the other propeller in the rear. And thereby hangs a tale.

An airplane's structure never fails in the air nowadays; it is either loss of control or stoppage of the motor that causes trouble. The use of two motors, one on either wing, increases the possibility of motor trouble if anything. And, while theoretically a twin-engined plane may continue flight on one motor, the unbalanced thrust of a single off-center propeller is dangerous in flight, and a difficult problem in control for the pilot. The arrangement in tandem avoids this difficulty, since whichever engine is in operation singly, the thrust is always central. Navy designers are, therefore, confident that the super seaplane will be capable of sustaining flight indefinitely on one motor.

We have spoken of the new seaplanes as comparatively slow, yet they should have a speed of over 100 miles per hour. Nothing illustrates progress in design better than a comparison of this latest giant with the NC-4 which crossed the Atlantic only five years ago. With the same power, since the NC-4 had four Liberty motors of approximately 400 horsepower each, the maximum speed was only 75 miles per hour. The NC-4 weighed 28,000 pounds and only had a range of 1,600 miles. The super seaplane is 4,000 pounds lighter, yet has a range of 2,600 miles and can fly in a single hop from San Diego to Honolulu. This will be the greatest range ever attained by any plane, land or water. True Macready and Kelly flew across the continent some 2,600 miles in a non-stop flight, but their Fokker monoplane was stripped bare, with just two pilots and gas. The new seaplane, while carrying gas enough for its maximum range, will carry two pilots, two mechanics and a radio operator as well as full fighting and bombing equipment.

It is interesting to analyze briefly the cause of this progress. While no drawings

of the new ship are yet available, it may be shrewdly surmised that it has the general lines of the PN-7 Navy long-distance scout, of which a photograph is shown. The NC-4 had a mass of struts and wires in its wing structure. This was because it had a comparatively low lift wing, and a correspondingly large wing area; and also because its wing was thin in camber with a correspondingly low strength to resist bending. Modern high lift wings not only reduce the area and the span, but with their great depth of camber allow the use of long unsupported spans reducing the external wing bracing to a minimum.



Bureau of Aeronautics, Navy Department

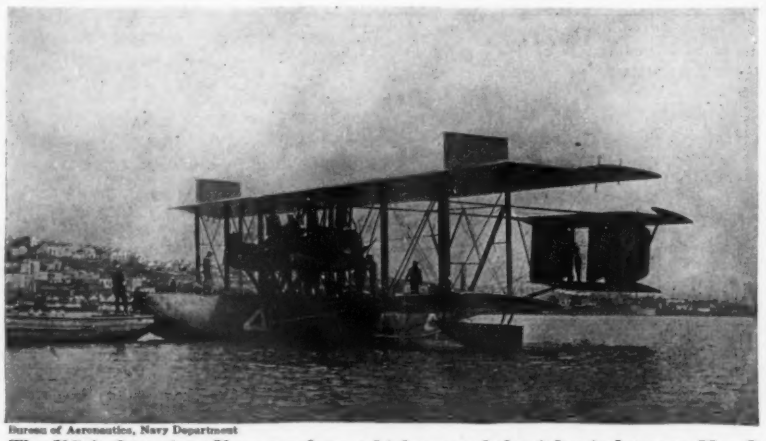
The PN-7 long distance Navy scout, the forerunner of the new giant super seaplane. The clean wing truss is interesting in comparison with the clumsier NC-4

The use of metal hulls and metal wings has greatly diminished the structural weight of these huge flying boats and the saving has gone partly into increased fuel-carrying capacity. Saving in structural weight and decrease in the air resistance of the wing truss have combined to give us the greater speeds. To this in the super seaplane, as already stated, is added the effect of the more efficient geared propellers. Thus, while new airplanes show no miraculous improvements or extraordinary changes, they are showing a constant, steady improvement from every point of view.

The Vickers airship has a length of 695 feet and a maximum diameter of 132 feet. The structural weight must not exceed 90 tons out of a gross lift of 152 tons, and in addition to fuel and oil for 2,500 miles plus 50 percent reserve, there will be available as pay load 120 passengers and 10 tons of freight and mail. Thirty-four berth cabins are provided along the sides of the vessel and in addition there is a smoking room, a lounge big enough to dance in, the usual accommodations for kitchens and quarters.

The passengers' quarters are completely isolated from the rest of the ship, not only by gas-tight walls, but by an air space through which free air will constantly be circulating, so that the fire risk from a passenger's carelessness or ignorance is reduced to a minimum. The total lift is 152 tons, and with seven power units of 550 horsepower each, the cruising speed will be 70 miles an hour. The Cardington airship is to have a slightly greater lift of 155 tons, with 20 tons available for passengers, freight and mail in addition to about the same fuel capacity as the Vickers airship. The length is 720 feet, but the diameter is only 130 feet.

Why this sudden jump in size and lift from the dimensions of such air giants as the Los Angeles and the Shenandoah? Because engineering development always follows basic principles, and the basic principle for airships is that the greater the size, the greater the possible speed and range. The resistance of the airship varies as the surface, that is, the square of the linear dimensions; its lift varies as the volume of the cube of the linear dimensions. Hence the greater the size, the less the fuel required for a given range, and the greater the pay load. The Los Angeles, hydrogen filled, and with a range of 4,500 miles could only carry five tons pay load, and its cruising speed was not much more than 50 miles an hour. The specifications for these two ships call for a range of 2,500 plus 50 percent; that is, 3,750 miles, a cruising speed of 75 miles an hour, and a pay load of 20 tons. The advantage of the larger ships is beyond dis-



Bureau of Aeronautics, Navy Department

The NC-4, first giant Navy seaplane, which crossed the Atlantic between May 8 and May 31

Super Airships

DREADNAUGHTS then super dreadnaughts. Airships then super airships. The British Government whether Labor or Tory is always thoughtful of the Empire and its communications. The Labor ministry shortly before its fall gave orders for the construction of two giant airships each of 5,000,000 cubic feet capacity. One of these has been placed with the Airship Guarantee Company, an associated company of the famous Vickers concern, and termed familiarly the "Capitalist" ship; the other was placed with the government's own Cardington works, and dubbed the "Socialist" ship accordingly. Both airships are to be put in commission in 1927 and are budgeted on a range of 2,500 miles, the length approximately of four stages between England and Australia. It is hoped in particular to bring India within four days' journey.

pute, and while these are only estimates, yet they are perfectly reliable—airship design has reached the point where such predictions can be safely made.

It must not be concluded, however, that airships can grow indefinitely in size. Small flying structures—or small static structures such as bridges for that matter—are always lighter in proportion to the load carried than larger structures, and while bigger ships improve on the score of air resistance and fuel consumption, their structural weight grows steadily as a proportion of the whole lift. Crocco, the famous Italian engineer, estimates that the two tendencies counterbalance one another at about 10,000,000 cubic feet and that it will not be feasible to build beyond this approximate limit.

The question of cost also has a direct relationship to size. With larger airships the cost of designs, the number of parts and the cost of assembly do not increase anything as fast as the gross weight. S. H. Phillips, in United States Air Services, estimates that for a ship of 1,000,000 cubic feet capacity the cost will be $1.00 per cubic foot. For 5,000,000 cubic feet it should drop to 60 cents per cubic foot. This should make one of these giants worth about $3,000,000. The *New York Times* reports the cost of the Vickers ship as £350,000 or roughly $1,575,000, and this figure, allowing for lower labor costs in Great Britain, seems reasonable. This comparatively low figure is hopeful for the commercial success of these Empire lines.

The United States, as is well known, has a monopoly of helium gas and the British must, therefore, use hydrogen, without discussing the pros and cons of the two gases. Perhaps this apparent handicap will prove an actual advantage to them. Hydrogen with its greater lift is advantageous from a pay load point of view. And the British, while forced to face a greater fire hazard, are meeting it by boldly turning to engines burning heavier and non-inflammable fuels.

In the Vickers-built ship the revolutionary results obtained recently by Ricardo will be made use of, and hydrogen will be burned in the engines in conjunction with kerosene. As an airship consumes liquid fuel its gross weight necessarily decreases. To counterbalance this loss in weight the lifting gas must either be allowed to escape, as is customary with hydrogen, or there must be weight compensation by recovery of water from the exhaust gases, the method employed in the Shenandoah. The ballast-recovery method has one serious objection—the huge radiators which cool the exhaust gases and allow the water to condense also offer large air resistance and cut down speed and range. The Ricardo method of burning the hydrogen, not only avoids the waste of this gas, which while cheaper than helium is still valuable, but also increases the range or the pay load at will, the consumption of the liquid fuel being reduced from .55 to .35 pounds per horsepower hour. An increase in range of something like 50 percent becomes possible.

In the Cardington ship, the British have gone even further and are burning heavy crude oil in the 600 horsepower engines. Besides being non-inflammable, the crude oil only has one-seventh of the cost of gasoline.

Newspaper cables of technical developments are sometimes inaccurate, but they contain a mine of rapid information nevertheless. The *New York Times* correspondent informs us that stainless steel will replace the duralumin which has become synonymous with airship construction. This must be a high tensile strength alloy steel. Steel with a tensile strength of say 150,000 pounds per square inch is practically as advantageous from a weight point of view as duralumin. With a strength of 200,000 pounds per square inch the structure becomes even lighter. But in small ships, the parts theoretically strong enough become too thin and locally fragile for the theoretical strength to be realized. In the super airships it becomes possible to utilize high tensile steel to its full advantage. Perhaps the metallurgist may even give us a steel of enormous strength which may nevertheless be welded and avoid the enormous expense of innumerable rivets. At any rate the projected British ships will give a tremendous impetus to the use of dirigibles for commercial undertakings.

A Commercial Aircraft Carrier

IF the Navy uses aircraft carriers such as the Langley with success, why should not the same principle be applied to commercial ships? Sir Eustace d'Eyncourt, formerly British Director of Naval Construction, has designed an ocean greyhound of 25,000 tons, with a flush upper deck 600 feet in length and over 100 feet in width, with funnels replaced by ventilating ducts at the rear, capable of housing twenty airplanes in its hold. The suggestion is that such a ship could make a non-stop trip between two important ports, but receive mail, passengers and fast freight from half a dozen ports not far from its route without breaking the journey.

Easy Piloting Through Use of Servo-Motors

IN steady flying the manipulation of the controls seems an easy matter, imposing no great demands on the strength of the pilot. But with heavy machines and long flights, this apparently easy task soon becomes fatiguing. *L'Aerophile* describes the installation of servo-motors on a French airplane. The plane retains the usual "joy-stick" and rudder-bar, but instead of these devices actuating the control surfaces directly by means of cables passing over pulleys, they serve to throw in and out of action small electric servo-motors whose torques intervene to work the control surfaces. The apparatus is simple and such as any electrical engineer could readily design.

So far pilots have looked askance at servo-motor systems, but if they can be made absolutely reliable and easily thrown out of gear in emergency, they may become of general use for the drive of large machines.

Devices to Facilitate Winter Flying

WINTER flying has been carefully studied by the Royal Canadian Air Force, in a country whose climate gives ample opportunity for such investigation. Flying has been found possible, even easy, in the coldest weather and at altitudes of over 10,000 feet. But in addition to warm clothing for the pilot and a carefully screened cockpit a number of devices have been found necessary, as described in the *Journal of the Royal Aeronautical Society*.

These devices might be as interesting to motorists as they are to aviators. A mixture of denatured alcohol and water is a fine anti-freeze mixture for the engine, but unfortunately this mixture has a low boiling point particularly at the low pressures of altitude. When the engine does warm up, the mixture is liable to boil away. This difficulty has been met very ingeniously. The usual vent at the top of the radiator is closed, and a pipe is carried from the filler cap through a cooling coil, discharging below the surface of the liquid in an auxiliary tank which is also open to the air. On starting up the engine, as soon as the anti-freeze mixture begins to boil, the vapor is condensed and either goes back into the radiator or is discharged into the auxiliary tank. When the engine is throttled for a glide or otherwise cooled down, the pressure in the radiator falls and the fluid is sucked back into it from the auxiliary tank. Thus, loss of the anti-freeze mixture is entirely avoided.

To start the engine a *measured* quantity of gasoline and ether is used as a dope.

An airplane fitted out with broad skis can not only, make a get-away or land on snow, but can actually be steered. Two front skis carry the bulk of the airplane's weight, a rear ski is turnable like a rudder, and the airplane can be turned with perfect readiness. Even an amphibious flying boat, with skis replacing the wheels, has been landed on snow and ice.

Timing Air Races to the Fraction of a Second

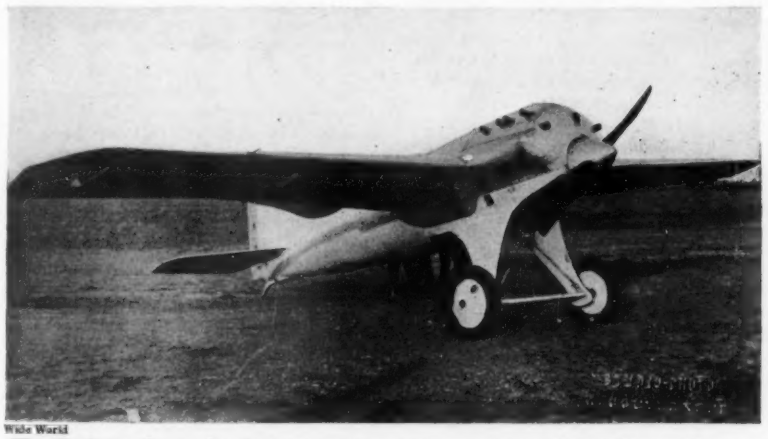
THE speeds of air races are invariably given to two places of decimals. It seems almost incredible that such accuracy should be attainable. It is attainable because of a special instrument, the only one of its kind in the world, invented by Odis Porter of Indianapolis. As a plane comes in sight of the timer, a sighting device is trained on it and follows it until the instrument strikes the exact center of a table, directly in front of the observer. When this point is reached, the instrument automatically releases the hammer of a chronograph, which prints the time to the fraction of a second.

Williams

Nothing is so helpless as a seaplane at sea with its motors out of commission. On the Rohrbach, flying boat of German design, masts and sails have been fitted and used

Motor Wanted

NOTHING better being available, the builders of light planes had to use motorcycle engines. Those that used four-cylinder engines had little trouble with their power plant. But those that used two-cylinder V engines had constant trouble. Vibration characteristics of such engines are very bad. A writer in *Aviation* points out that engines which run smoothly and continuously when installed in motorcycle frames may refuse to give even one minute of non-stop operation in the fragile fuselage of an airplane. French and English manufacturers have produced specially designed light motors for aviation use. A similar development is urgently needed in America.



Wide World

The Ferbois plane, the fastest airplane in France, in which Adjutant Bonnet set a new national record of 390 kilometers an hour

Flying Blind

PILOTS are generally men of deeds not words, and it is very rarely that one of them can be made to give a detailed description of his feelings and practical difficulties in steady flying. Such information is extremely valuable from the point of view of the airplane designer, the commercial operator and the maker of flying and navigation instruments.

F. T. Courtney's paper before the Scottish Branch of the Royal Aeronautical Society on the Practical Difficulties of Commercial Flying contains some pertinent and unique observations. He makes one epigrammatic statement among many, "Flying is popular in the sense that people like flying, but it is unpopular in the sense that people will not fly." Yet with close experience of the matter, Mr. Courtney is of the opinion that the element of danger is only a very minor cause for the lack of passengers on the London-Paris routes. People gladly take the slightly greater hazard for the sake of convenience and rapidity. Increased costs have apparently little relation to the question.

The main drawback is irregularity of service, the inability to fly in foggy or very cloudy weather. Engines and airplanes are good enough. Lighthouses and beacons are a great help, but may be invisible in fog. Navigational instruments are good enough theoretically, so that the ship may be flown with no visibility at all, by instrument solely. But the main practical problem is that the pilot is not a machine, but a human being. All his life whether in the ground or in the air, he has directed himself by sight. Mr. Courtney tells us that he must be trained and specially trained to fly completely "blind." "And I strongly contend that all commercial pilots should be given plenty of practice in this blind flying when not engaged in their ordinary flying.

"Assuming that the pilot has become able to control and maneuver his airplane in continuous cloud, he must, under these conditions and at night, be able to find his way from one airdrome to another without colliding with other airplanes on the same route. He must be able to descend on the ground and yet not strike ground obstructions. Although this looks difficult I am quite sure it can be done. I will go so far as to say that with proper experiments an airplane could fly with no better equipment than is now available in all weathers, by day or by night, and be able to do all that is wanted of it."

Letters From Our Readers

A Curious Kind of Lightning?

In response to our recent request for information about occurrences of "ball" lightning or similar phenomena, Mr. O. B. Stephens of Bemidji, Minnesota, submits the following interesting experience.

Some electrical phenomena is a more probable cause, we imagine, than a form of strange will-of-the-wisp as suggested by Mr. Stephens.

His letter follows:

I was at Finley, North Dakota, harvesting last fall. There one evening I saw an uncommon and very strange sight, probably some form of "Ingnis Fatuns." We had had a few days real hot sunny weather, before and including September 10, ult. And in the evening at about 9 P.M. it was still mild and nice, but rather dark. I was just outside the house facing east when suddenly a dull ball of light appeared in the air about ten feet above ground and moving swiftly toward me and about sixty feet away. Color greenish yellow, and size of a baby ball five to six inches in diameter.

When it came within twenty feet of me, it suddenly exploded, without noise. Then it separated into a number of smaller parts all perfectly round and about the same color; for all the world like the performance of a sky rocket. The farmer was approaching me from the barn, toward the east, with a lantern in his hand. Nevertheless the extra light attracted his attention so that he asked me, "what light was that?" He had not seen the cause of it.

I am now nearly seventy-five years old but never saw anything else like it.

Yours truly,
O. B. Stephens.

Bemidji, Minn.,
December 4, 1924.

Captain See vs. Doctor Einstein

Captain T. J. J. See, Professor of Mathematics at the Mare Island Navy Yard, California, writes us the following interesting letter in response to our editorial favoring the Einstein Theory of Relativity, as printed in the issue for December, 1924. While we remain, absolutely and unequivocally, on Dr. Einstein's side of the fence rather than on Captain See's, the captain's references and suggestions will be of interest to many of our readers as an authoritative presentation of an argument which the captain has been making for some time and which has not always been quoted in the newspapers as correctly or as fully as scientific considerations would make desirable.

Mare Island, Calif.
November 28, 1924.

Editor of the Scientific American:

In the December issue of your valuable paper, page 388, you discuss my recent criticisms of the Einstein Theory; and, as the *most essential points* are not touched upon, I will call attention to some considerations of fundamental importance.

1. In this editorial you dwell on the deflection of light to the exclusion of even more vital objections. One of the chief points of my recent criticism was that Einstein explains half of the observed deflection by the *curvature of space*, claiming that the Newtonian Law failed to account for the observed effects. Omitting a few points not yet fully cleared up, the latest results, on which mathematicians are agreed, may be condensed as follows:

(a) In the Philosophical Magazine for 1923, volume 45, page 243, Sir Joseph Larmor has found an erroneous factor 2 in Einstein's 1916 calculation of the deflection of light near the sun. Professor Charles Lane Poor discovered this error independently, and has confirmed Larmor's work. This makes the calculated deflection by the corrected Theory of Relativity 0.87 second of arc, in exact agreement with the value calculated by Soldner in 1801 from the Newtonian Law, 110 years before relativity was thought of. I have carefully investigated Soldner's results, and my results agree with the above—namely that Newtonian Theory accounts for all known phenomena. Thus the part of the Einstein Theory involving *curvature of space* is wholly unnecessary, and hence I have opposed it for years, especially emphasizing my opposition recently, because of conclusive proof that the doctrine of the curvature of space is a delusion.

2. There are so great a multitude of errors in the Theory of Relativity that I am making a systematic catalogue of them. I will here mention just a few:

(a) Gauss usually is cited as if he were a believer in the curvature of space. In the authoritative Memorial, 1856, by Waltershausen, who was long intimate with Gauss in his old age, it is stated (page 81) that Gauss held as an inmost conviction that to the human soul space is one of three dimensions and not higher.

(b) Gauss dealt profoundly with the *curvature of surfaces in space*, but never once even spoke of the *curvature of space*, or applied his equations for three dimensions to spaces of fourth and higher dimensions. Accordingly, the relativists have grossly misrepresented Gauss, and in effect falsified the history of mathematics. This is a just subject of complaint, and should be noted by careful students.

(c) Riemann was the inventor of the misleading theory of the curvature of space. Because of his increasing illness (and death on February 23, 1855) Gauss never read nor approved Riemann's paper of June, 1854. It was not published till 1867, a year after Riemann's death, yet has produced a deception which long passed unnoticed, until pointed out by me.

(d) Riemann's chief error consists in changing the units of measurement in one only of the two members of an equation. He leaves the divisor of the left member unity, but absurdly puts that of the right member unity plus kappa, where kappa is a small quantity involving the curvature of space. This procedure violates the integrity of the equation. It is analogous to the conduct of a cashier who would plunder the capital of a bank by one percent, and then claim he had 100 percent capital, by making each dollar 99 cents.

(e) The criticism here made is implied in Euclid's seventh axiom: "Things which are halves of the same thing are equal to one another." *In other words, if you divide equals by any divisor, the divisor must be the same for both: you cannot change the unit in one side only of an equation, making it unity plus kappa, on the right, yet leaving it unity on the left.* This disposes of Riemann's equation for the curvature of space. It is much quoted by the relativists without perceiving the unlawful character of the procedure; which shows that the mathematical intuition of the relativists is not as high as some people suppose.

3. Another related point is the misleading doctrine that there is a *radius of world curvature*. For years I have recognized this whole doctrine as wrong. Let us notice two recent results:

(a) Twice during 1924 Dr. L. Silberstein of Rochester has published calculations on the radius of world curvature, the first value leading to about 100 million light-years, the second to 114 million light-years.

(b) In the Monthly Notices of the Royal Astronomical Society for October, 1924, Dr. K. Lundmark publishes an exhaustive discussion of all the known facts.

He finds many of the values of R imaginary, and where they are real that the "value can not be deduced from existing data with any accuracy."

(c) In my own argument against the curvature of space it is shown that curvature of space does not exist, because any curvature (as of a sphere surface) which might be imagined about any point *p* of the celestial sphere would be exactly counterbalanced by the equal and opposite curvature about the opposite point *p* of the celestial sphere. Hence curvature of space is a deception, and there is no such thing as radius of world curvature. Gauss himself supports the view that space is of three dimensions, as cited above.

4. From your discussion of the motion of Mercury it would appear that you are unfamiliar with my paper in the *Astronische Nachrichtungen*, Number 5048, June, 1920, in which I point out seven other explanations of the motion of Mercury, besides that given by Einstein. The explanation given by me is the simplest of all, being confirmed in Newcomb's "Fluctuations of the Moon's Motion," and agreeing essentially with a suggestion outlined by Sir Isaac Newton in the "Principia," in 1686.

(a) Einstein's explanation hangs on the outstanding difference of 43 seconds of arc in the centennial motion of the perihelion; yet in Astronische Nachrichtungen, Number 5115, 1921, Dr. Grossmann of Munich shows that the difference most likely is only about 28 seconds of arc.

(b) Moreover, I have shown that gravity is due to waves in the ether, propagated with the velocity of light; and thus 14.5 seconds of arc should be deducted from the outstanding difference in the motion of the perihelion. Even if the figure be 43 seconds, the residue could not possibly exceed 28.5 seconds, and thus Einstein's theory collapses.

Hence my result agrees with Grossmann's from another point of view, and both confirm Poor's calculations in absolutely denying the relativity explanation of the motion of Mercury.

6. The relativist Eddington says:

"The earth moves in a curved orbit, not because the sun exerts any direct pull, but because the earth is trying to find the shortest way through a space and time which have been tangled up by an influence radiating from the sun." (Harrow's "From Newton to Einstein," page 67.)

What amazing reasons to come from Cambridge! Was it not Huyghens' "De Horologio Oscillatorio," 1673, that first established the laws of centrifugal force, 251 years ago? Did not Newton fully confirm Huyghens' reasoning, in the immortal "Principia," 1687, so that we have since had 250 years' confirmation of the laws of centrifugal force?

The laws of centrifugal force are easily verified by any boy who whirls an apple by a string tied to the stem. As the whirling speeds up the stem will pull out or the string break and the apple will fly away on a tangent.

This is a *fact*, not a *theory!*

The force or central pull required to curve the earth's orbit about the sun is easily calculated to be equivalent to 3.6 millions of millions of millions of tons, equivalent to the breaking strength of an eleven-inch cable of the strongest steel on each square foot of a cross section of our globe; *so that our earth practically would have to be covered with a solid forest of steel cables to hold it in its orbit.*

Yet in spite of this demonstrated fact, known since the days of Newton, Eddington and other relativists go on diffusing the most monstrous errors over the world.

Under these circumstances I hope you will see that our objections to the Einstein theory do not rest on a few features, but on many! The objections are profound, and cannot be overcome by any process of evasion.

In fact relativity is definitely and finally disproved—as dead as the Dodo—and no amount of effort will galvanize it into life again.

Yours truly,
T. J. J. See.

Frozen Clouds

AN unusual and interesting experience with a cloud that froze while one looked at it is described by Mr. Bertram E. Hall. He writes:

I am spending the winter alone in a United States Forest Ranger cabin in the very heart of the Black Hills National Forest, South Dakota. Recently I had a very interesting experience on the summit of Custer Peak.

A frozen cloud is no unusual phenomenon. Even on a warm summer day the highest clouds—the fleecy white cirrus—are ice particles suspended from a few thousand feet to several miles above the surface of the earth. But to be enveloped within such a cloud is an experience that is quite unusual.

My cabin is in the higher ranges of the northern hills; the entire area is forest clad and wild life abounds. Above me Custer Peak thrusts itself 6,794 feet into the blue.

December 3rd, last, proved an unsettled day in the Black Hills. In mid-afternoon it ceased snowing for about the fourth time that day and a few moments of welcome sunshine seemed to promise a resplendent evening. A freshening wind quickly disillusioned the hopeful. A storm cloud settled over Custer Peak and the sky became overcast.

It was this cloud on the peak that attracted my attention. It was of a whitish gray color, and as the thermometer said that any cloud resting on Custer Peak must be frozen, I went to the summit. The cloud proved to be fog. It had formed directly over the mountain and the latent heat of condensation had, as yet, prevented actual freezing, but the settling water particles soon cooled and a very rapid frost formation took place.

The lower cloud became a cloud of frost that attached itself to every rock cliff and tree on the cold summit. The cloud descended only so far. Below that level not a particle of frost appeared on the ground. In other words, there was no precipitation in the sense of falling snow or rain. Only where the frozen cloud actually touched the mountain, was there frost deposited. Finally the wind blew the cloud away.

The setting sun did succeed in a half-hearted attempt at shining. As the light struck the frost-covered peak it burst into a glory that defies description. Every frost particle gleamed like a thousand diamonds.

BERTRAM E. HALL.

The Heavens in February

By Professor Henry Norris Russell, Ph.D.

NIGHT SKY: FEBRUARY AND MARCH

ON our map of the skies for February and March we find the grand group of winter constellations—Orion, Canis Major, Canis Minor, Taurus, Gemini and Auriga—in the west and southwest, extending to the Zenith. Perseus, Cassiopeia and Andromeda are in the northwest; Cepheus, Ursa Minor and Draco in the north; Ursa Major in the northwest with Boötes far below on the right; Leo and Virgo a little south of east and, Hydra in the southeast.

The Planets

Mercury is a morning star all through the month but is hard to see except at its very beginning, when he rises just after 6 A.M. Venus is also a morning star, close to Mercury and far brighter, so that she may easily be seen. Mars is now well past quadrature and is an evening star in Aries, setting at 11.15 P.M. in the middle of the month.

Jupiter is a morning star in Sagittarius and rises at 5 A.M. or a little before. Saturn has passed quadrature and is no longer called a morning star, although, being well south of the equator, he does not rise until about the middle of the night. Uranus is an evening star in Aquarius, and sets too early to be observable. Neptune is in opposition on the 10th and is observable telescopically all night.

The moon is full at 5 P.M. on the 8th, in her last quarter at 5 A.M. on the 16th, new at 9 P.M. on the 22d, and does not come to the first quarter till March 2d, so that we have the rather unusual circumstances that there are only three "quarters" in this month—which can happen only in February. The moon is nearest us on the 20th and furthest away on the 4th. She passes near Neptune on the 8th, Saturn on the 15th, Jupiter on the 19th, Venus on the 21st, Mercury on the 22d, Uranus on the 23d and Mars on the 27th.

At the time of full moon she undergoes a considerable partial eclipse, only the ending of which is visible in America. She enters the earth's shadow (the umbra) at 3.09 P.M. (Eastern Standard Time), is most deeply immersed at 4.42 and leaves the umbra at 6.15, rising to our eyes, almost as the eclipse is over.

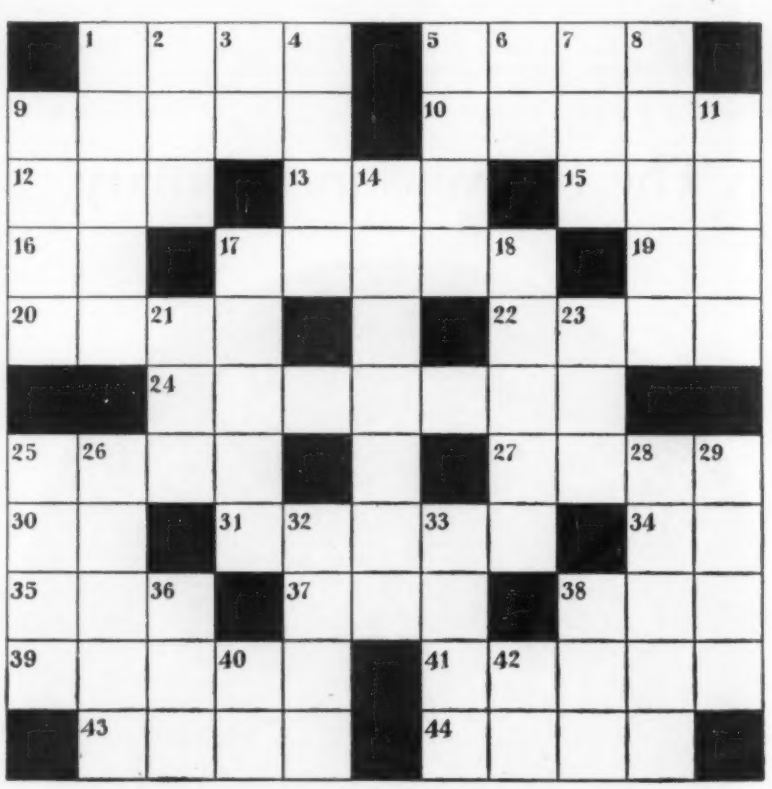
A Cross-Word Puzzle

Test Your Knowledge of Scientific Terms. Earn a Credit Toward a New Subscription

By Jack Barrett

LIKE everybody else, the Scientific American has succumbed to the cross-word puzzle craze. All the words in the puzzle printed on this page are technical, industrial or scientific terms or are words frequently used in technical writing. *All these words are contained on pages 111 to 144 of this issue of the Scientific American.* Some of the words will be found in the text, some of them in the advertisements.

If you can solve the puzzle and can find the place of each of the words in this issue, by page, column and line, we will give you a credit slip of one dollar toward a new subscription for the Scientific American. By a little mental exercise you can give a friend the useful present of a year's subscription to our magazine at a cost (in the United States) of only three dollars. All the conditions are explained below.



How to Solve the Puzzle

THE numbers in the squares refer to the definitions. Thus: 1 Horizontal calls for a word that will answer the definition and at the same time fit into the number of white squares running horizontally from Number 1 to the first black square to its right. 1 Vertical applies in the same way except that the right word must fit into the number of squares from Number 1 downward to the first black square. When all the correct words have been inserted the words will interlock and the puzzle is solved. In starting to solve the puzzle, go through the definitions and fill in all the words you are sure of first. You will find that the letters thus provided will give you keys to the more difficult words. Whenever you insert the letters in the squares of a vertical word it is a good plan to check that word with a horizontal word crossing it, and vice-versa.

How to Get Your One Dollar Credit Memorandum

THE definitions printed on the next page give you the keys to the puzzle. When you have identified each word, look through the pages of this issue, between page 111 and page 144 inclusive, until you find that word. Then set down the page, column and line on which you found the word, in the blanks provided for that purpose. Clip out this whole half-page; puzzle, filled-out blanks and all; and send it to us. If your solution is correct and if all the words are properly placed, according to page, column and line, we will send you immediately a credit memorandum good for one dollar toward a new subscription to the Scientific American. This subscription may be in the name of anyone you like. Only one credit memorandum is good on each subscription. The $3.00 balance ($4.00 for foreign subscriptions) must be paid in cash or by check.

Some of the correct words may occur at more than one place on pages 111 to 144. This makes no difference. A reference to one place for each word is sufficient, provided that reference is correct. Each word must be found on pages 111 to 144 of this issue, inclusive. No other page will do.

If you fail to solve the puzzle and want to know the solution you do not need to wait for our next issue. Send us the best you can do toward the solution and we will mail you the full and correct one immediately.

It is not necessary to clip this page unless you wish. Your solution may be sent us on a sheet of paper. But be sure to give *every-one* of the words and the *exact place* where you found *each one* in the specified pages of this issue.

To be considered for credit solutions of this puzzle must be mailed to us before midnight of February 19, 1925. A new issue of the Scientific American will appear on February 20th and will carry another cross-word puzzle on which you can test your wits during March.

Address: Cross-Word Editor
Scientific American
Woolworth Building
New York, N. Y.

Insert in the blanks below the places on pages 111 to 144 of this issue where you found the correct words of the puzzle. No other pages will do. The exact position must be given for each word.

Definition (Use these definitions in solving the puzzle).	*Page* (the number printed on the page)	*Column* (1, 2, 3 or 4, counting from left to right)	*Line* (by number, counting downward from the top)
HORIZONTAL:			
1. A kind of reproduction made of metal.			
5. A material used in making mortar.			
9. Articles used in producing hollow metal castings.			
10. A substance used in grinding and polishing.			
12. An abbreviation for last month.			
13. An animal much studied by modern psychologists.			
15. A way of fastening things together.			
16. An ejaculation associated with poverty-stricken Indians.			
17. Men who have completed a college course (abbreviation).			
19. Abbreviation for a state of the United States.			
20. A group of three.			
22. A row of stacked boxes or other articles.			
24. A modern type of railway car.			
25. To arrive.			
27. Completes or measures out.			
30. An ancient beast of burden.			
31. A well-known class of solid substances.			
34. The word probably commonest in the French language.			
35. A device used in forming metal articles.			
37. Abbreviation for a part of Australia.			
38. A process destructive to wooden fence posts.			
39. An important class of tools.			
41. The wires of a radio set.			
43. Periods of time much discussed in geology.			
44. Tools for cutting wood.			
VERTICAL:			
1. An important physical property of minerals.			
2. A way of representing ideas or natural objects.			
3. Abbreviation for one of the secondary points of the compass.			
4. A Slavic modification of the ancient title of the Roman Emperors.			
5. The thing which characterizes the highest types of plants.			
6. A verb expressing existence.			
7. A remainder left after subtraction.			
8. An essential part of an automobile.			
9. A word for beliefs that draw people together.			
11. A unit determined by the earth's motion.			
14. Protections for scientific discoveries.			
17. A mythical monster much discussed by experts in folk lore.			
18. A combination consisting essentially of iron and carbon.			
21. A derogatory term for a firmly held doctrine.			
23. To irritate.			
25. Something every radio expert should know.			
26. Chemical name for the class of compounds commonest in the earth's crust.			
28. A name given to units of the pretended "odic electricity."			
29. Something that a printer often does with type.			
32. The most important parts of a nail.			
33. Tools used by carpenters.			
36. The chief thing investigated by introspective psychologists.			
38. An adjective applied to cotton before it is spun or processed.			
40. A unit of measure.			
42. The name of a Babylonian god.			

Our next issue will contain another cross-word puzzle. Unless you are a regular subscriber better ask your newsdealer to reserve a copy of the March issue (out February 20th) for you.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Austin C. Lescarboura

Beam System Increases Radio Range

ACCORDING to recent, more detailed announcements of the Marconi Company, in England, experimental work with the radio reflectors and the beams of radio waves, devised by Senator Marconi and Mr. C. S. Franklin, continues to show a substantial advantage for this system in obtaining distant transmission with comparatively low power.

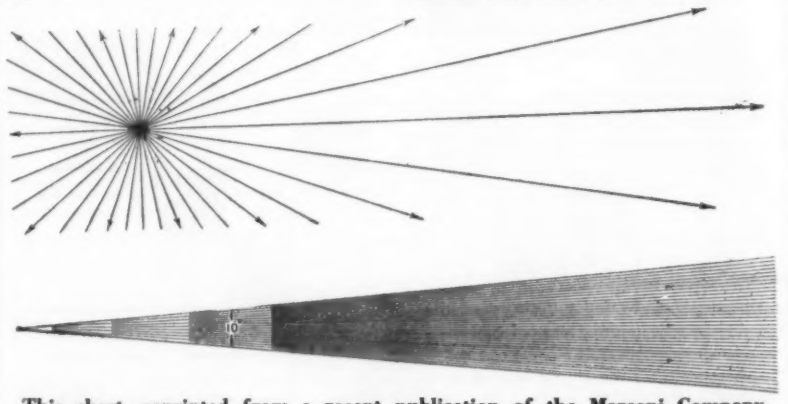
The system depends, it will be remembered, upon the more or less complete concentration of the radio energy into a directed beam, much as the light of a searchlight is concentrated into a beam instead of being allowed to spread outward in all directions as radio waves do from ordinary transmitting stations. Even when the concentration of the beam is not more perfect than corresponds to an angle of spread of ten degrees, the results of American listeners on measurement of the strength of beam signals received from Poldhu, England, indicate that a given transmitter working on a beam will have about as much transmission range as would a transmitter one hundred times as powerful working in the usual fashion.

Shortwave Possibilities

THE possibilities of developmental work in short waves are attractively presented by Dr. George K. Burgess, director of the Bureau of Standards, when he says: "In the exploitation of the high frequencies (short wavelengths) the radio world finds itself in the position of a person who has fallen heir to a rich legacy, for there is now available for actual use a region roughly twice as great as radio had at its disposal a year ago. Calculated on the basis of channels ten kilocycles wide," computes Dr. Burgess, "the gain appears far greater than this, since between 2,000 and 20,000 kilocycles there are 1,800 such channels, as compared with only 200 such channels in the older region below 2,000 kilocycles.

It will, however, probably be a long time until full advantage can be taken of the channels thus theoretically available.

Assuming that at present receiving sets can satisfactorily receive stations situated at equal distances having a frequency separation of 2 per cent, there are only 116 channels immediately available, as against the 1,800 channels theoretically available.



This chart, reprinted from a recent publication of the Marconi Company, London, shows how greatly the energy of a radio transmitter is saved by the beam system, concentrating the waves in a small angle pointed in a single direction.

Pyrex Glass for Insulation

MANUFACTURERS of low-loss condensers are now using pyrex insulation with excellent results. One manufacturer of radio apparatus has now brought out a pyrex glass low-loss tube socket. It is claimed that exhaustive tests, covering a period of more than twelve months, proved that pyrex was the lowest-loss insulating material for radio-frequency circuits yet presented, with the exception of quartz. It is strong and heat resisting, and does not absorb moisture. Even the heat of a soldering iron does not affect it. It is entirely free from surface condensation, and is unaffected by those influences which make most of the usual insulating materials more or less unsatisfactory on weak signals.

An Audience of Twenty Million

THE address of President Coolidge on the eve of Election Day, was broadcast direct from the White House through twenty-seven broadcasting stations. This constitutes a new record for the use of telephone lines to tie broadcasting stations into a single broadcasting unit. Previous to this feat the Defense Day demonstration, which combined eighteen broadcasting stations in order to reach the radio audience from coast to coast, constituted the record in this direction.

Approximately 8,000 miles of main-line telephone circuits were involved in this presidential speech, as well as some fifty-odd repeaters and special amplifiers to make up the loss in volume of the voice as it traveled through the enormous network of wires to the different broadcasting stations.

Radio and the Patent Office

BECAUSE of the startling progress made in radio, the Patent Office has created a new division to handle applications for patents on inventions dealing with radio. The new division is known as the "Radiant Energy Division," and will be headed by C. D. Backus, who for fourteen years has been in the electrical energy division, while Dr. William A. Kinnan, First Assistant Commissioner of Patents, will supervise the new division.

Twelve examiners have been assigned to the new division, and already the division is reported to be the furthest in arrears of any division in the Patent Office. At the present time there are pending some 2,000 applications for patents on radio inventions, but with the new arrangements it is hoped that the Patent Office will soon catch up on radio patents.

New Kind of Bakelite Cabinets

WE have become so accustomed to bakelite as well as similar composition panels for our radio sets that we now take it as a matter of course in that connection. There is a decided novelty, however, in the new bakelite cabinets now being introduced by a manufacturer of bakelite products. These bakelite cabinets have all the beauty of fine grained mahogany, plus all the insulating qualities of bakelite. The actual material employed is so-called vulcawood, which is a combination of hard vulcanized fibre and bakelite. Vulcawood cabinets come in eight standard sizes, knocked down, and can be assembled in a few minutes with a screwdriver.

Patience Necessary for Distance Work

IT is universally admitted—and it would be true even if it were not admitted—that the one essential thing about getting distant stations to come in on any kind of receiver is precise tuning. This is not merely a matter of knowing how, it involves also the willingness to reset the adjusting dials over and over again until the station finally comes in. With the modern sets, on which the tuning controls stand at fixed positions for a given wavelength, the best system is to set the controls and wait for several minutes. If you hear nothing alter the controls very slightly and wait again, and so on until you get what you want.

The Effects of Impurities in Storage Batteries

WE have been told always to use only the purest water—if possible, distilled water—in making up the acid for storage batteries and in filling up the battery to the proper level when some of the water has evaporated from it. There has never been available, however, any precise information about just what different impurities in the water or in the acid might do to the battery or to its operation.

The United States Bureau of Standards has now determined to obtain this information. A preliminary report issued recently states that iron, manganese, chlorine and the bichromates affect both plates of the battery; that bismuth, starch and sugar affect only the positive plate, and that platinum, tin, copper, antimony, silver, nitrogen and tungsten affect only the negative plate. The experiments are to be continued with other materials.

Of the impurities which prove to be deleterious—or which, at least, affect the plates—it is probable that chlorine and iron are the ones most to be guarded against by the ordinary radio fan. Both of these elements are common impurities in domestic water supplies, chlorine in the form of common salt (which is sodium chloride) and iron in the form of the various iron salts which produce "rust" or iron oxide in the water when it is allowed to stand exposed to the air.

German Radio Patents and American Manufacturers

ON October 30 last the Navy Department decided to issue licenses to approximately sixty independent radio manufacturers under 129 German patents seized by the Alien Property Custodian during the World War. It appears that the majority of the patents and patent applications involved were originally owned by the Telefunken Company, according to the *New York Sun*. These patents include the basic patent covering tuned radio-frequency amplification—the well-known Wilhelm Schloemilch and Otto Von Bronk patent.

On February 5, 1919, the Alien Property Custodian sold to the Secretary of the Navy, representing the United States, all right, title and interest in and to said patents, which had been vested in the Atlantic Communication Company and acquired by him from it. The following day the Custodian also sold to the Secretary of the Navy all right, title and interest in and to the patents and applications which had remained in the Telefunken Company after the assignment to the Atlantic Communication Company, and which had been acquired by the Custodian.

Considerable legal complications caused these patents and applications to be held by the Navy for its own use, but finally the obstacles were swept aside and the licenses issued to the independent manufacturers, who are now in a strong position with regard to manufacturing efficient radio receivers under their own patent rights.

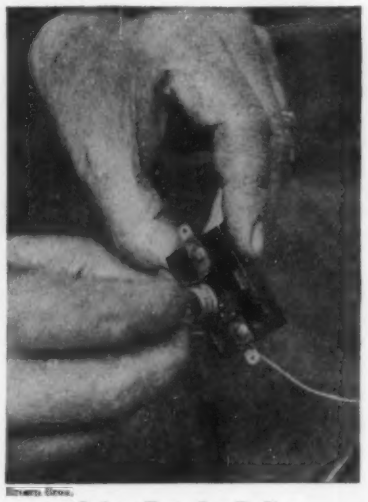
Insulation Leaks

MATERIAL that is good enough for general electrical work is not good enough for radio work, states Herbert H. Frost, well-known radio manufacturer. The amount of energy that is received in the average antenna is so minute that it is one of the wonders of the

present age that such a small force can be converted into words and music. The amount of current impressed on the grid of the vacuum tube is so small that to lose even the least bit through poor apparatus results in greatly decreased efficiency. Insulation leaks and poor connections that would pass unnoticed in ordinary electrical work, must be guarded against in radio. Most of the losses are not in connections which are made by the set builder; they are in the apparatus which he uses, and are losses which he can only guard against by buying good, standard products.

Beware the Radio Cult

THE public interest in radio and the ease with which radio can be made to appear mysterious constitute too good an opportunity of profit to be neglected by the promoters of this or that "ism" which thrives on the deluding of the public. The Abrams cult, discredited by the numerous adverse reports such as the recent one of the Scientific American's committee, is turning up in new forms purporting to use radio devices for the detection and cure of bodily disorders the very names of which are strange to sober-minded, legitimate medicine. We hear of "neurophonometers" and "neurocalometers." of the "vibrations" of one's ego, of "ionics" and "odics" and "elods" (whatever they may be). All are supposed to be related to the marvels of radio. The public should be warned. It is easy to make high-sounding words, much easier than to make scientific progress. Radio has not revolutionized medicine yet. It is not likely to. Most of the "marvelous discoveries" announced recently are nothing but the moonshine of some unscrupulous confidence man who ekes out a precarious income by exploiting any "mystery" in which he can persuade his victims to believe.



Safety Fuse for Radio

Present-day Crystal Detectors

THE advent of the reflex circuit in which a crystal detector is generally employed for converting the radio-frequency energy into audio-frequency energy, has brought back the crystal detector into extensive use. In order to get away from the troublesome adjustments of the conventional crystal detector with its delicate wire contact or "catwhisker," various schemes have been introduced to make the crystal detector more or less fool-proof. In some instances the detector is made with a fixed adjustment, so that this member never requires attention unless, through some cause or other, it loses its sensitivity, in which event it is replaced. As for adjustable crystal detectors, the trend is toward ready adjustment combined with some form of locking device, so that once a sensitive point is found on the crystal the detector may be locked for that particular adjustment.

One of the simplest yet most ingenious ideas which we have noted along these lines is a crystal detector with a wire screen placed over the crystal but not making contact with same. This screen is of fine mesh, yet permits the fine wire to slide through

the interstices to the crystal surface. The idea of this screen is to prevent the sensitive spot from being lost, once it is found.

Another ingenious idea comes from France. In this case a fiber disk is placed over the crystal, and ten wires pass through small holes in the disk and press against ten spots on the crystal. A ten-point switch enables the operator to cut into the circuit any one of the ten points. Thus, the operator has ten adjustments to select from. If none of these is found satisfactory, the crystal is shifted, bringing ten more spots under the ends of the wire.

strands of forty wires each, and six strands are twisted together to make the Litzendraht wire. Thus, it will be noted that there are 240 conductors enclosed in one cable, each conductor insulated from the others.

The reason why this wire is highly efficient for leads that carry high-frequency currents is because these currents travel only on the surface of a conductor. The cross-sectional area of the conductor means little except as it goes to make a larger surface; in other words, the high-frequency currents do not flow through the cores of the conductors, but only along the surface of the wires. Thus, by having a large number of insulated conductors in the Litz wire, we obtain a combined surface equal to that of a solid conductor several times as large as the Litz wire.

Radio experimenters have found Litz wire ideal for indoor antennæ, as well as in the making of loops. The main difficulty in handling this material is in the making of connections. Each tiny conductor being insulated with enamel, it is necessary to scrape off the enamel coating or polish it off with emery cloth in order to establish contact with each and every conductor.

Frederic M. Delano

Loudspeaker for Milady's boudoir, covered with Japanese paper and painted in various designs. Frames of wood can then be fitted to match the furniture

Half Way Round the World by Amateur Radio

THE radio amateurs of the United States recently received a rude shock when they heard of the long-distance records made by the busy amateurs of New Zealand. It appears that during the past September and October all amateur DX records were broken—and broken to such an extent that the ultimate has just about been reached. On October 19 last, z4AA, Frank D. Bell of Palmerston South, N. Z., was in communication with Mill Hill School, London, g2SZ, for a period of ninety minutes. On October 25, we learn further from *Q S T*, z4AF, Ralph Slade of Dunedin, N. Z., worked British 2NM, operated by Gerald Marcuse. The distance covered in the latter case was over 11,900 miles—almost half way round the world. Unless someone arranges to communicate with a ship diametrically opposite his station, on the opposite side of the earth, carefully arranging to achieve the world's maximum of 12,500 miles, it is very doubtful if the foregoing-mentioned record will be broken.

American amateurs have recently been communicating with New Zealand amateurs, and this long-distance communication would cause us to swell with pride were it not so greatly exceeded by the New Zealand-England communication. Who would ever have dared suggest that some day radio amateurs, using five five-watt tubes, would have attained this trio of records.

Why Litz Wire is Useful

IN these days of low-loss apparatus for making super-efficient regenerative receivers, we hear a good deal about Litzendraht wire or its American equivalent. This wire is used for inductance windings in which the high-frequency resistance must be reduced to a minimum. It is enameled stranded wire, and is made in twenty or more sizes. Nos. 20 and 38 are probably the most commonly used sizes of wire for the individual conductors, although much of the present Litz cable is made of wire only two thousandths of an inch thick, or the so-called 2-mill wire. This very fine wire, covered with enamel, is wrapped in

a non-standard base and so designed that it required slight changes in the wiring of standard receiving set, the new D-21 has a standard base, can be made to oscillate smoothly and easily, and is so designed that no wiring changes are needed. In fact, it can be substituted for a "gassy" tube or a "hard" tube without any other alterations.

The tube itself is quite small, but is surrounded by a frosted glass shell or envelope which shields the tube from draughts, inasmuch as steady temperature is important in the operation of the tube. The inner glass shell is the vacuum tube proper. It is sealed in the usual fashion, and contains the grid, filament and plate. The heater—a few turns of resistance wire—is wrapped around this inner tube. The heater is connected in series with the filament and serves to warm up the tube so as to keep up the best temperature for tube operation. This is necessary because the tube contains sodium vapor. When the tube is turned on, the filament at once glows a bright yellow, the heater warms up more gradually and after a minute or so the tube is in operating condition.

Not Enough Wavelengths

FOR a time, not so long ago, it seemed that our list of broadcasting stations was steadily shrinking, and some of us may even have entertained secret fears that the day would come when our receiving sets might be silent except for the dot-dash messages of workaday radio. However, it now appears that the tide has set the other way, and more and more broadcasters are getting on the air. Indeed, the situation now confronting us is an overcrowded ether. Nearly every Class B broadcasting station in the country, with the possible exception of those on the Pacific Coast, may be required to divide time at least two ways by the time these lines are read, according to the prediction of the radio bureau of the Department of Commerce.

Without going into the intricacies of the situation, it may be said that the number of new stations coming into operation and under contemplation has exceeded all expectations. There are now about forty Class B stations either under construction, or already operating in Class A or C and intending to transfer to Class B. Then there are some twenty more Class B stations being contemplated.

In the final analysis it appears that there are but forty-seven channels available for Class B stations, and more than 100 Class B stations will soon be in operation. Even with two stations sharing each channel, there will still be insufficient room on the air. Chief Radio Supervisor Terrel is looking forward to some strenuous days when he must arrange matters among the broadcasters. He is sure that a number of stations which now have exclusive wavelengths, are going to raise a rumpus when they will have to divide time.

Fotogramas

Blind Joe Alonzo, an Italian of the east side of New York City, is an expert radio mechanic and, despite his handicap, he builds radio sets of every description

New Tube Shielded from Draughts

THE new sodium tube which has now made its appearance is known as the D-21, and differs considerably from the old S-13. Like the former tube, however, it depends for its sensitivity on the presence of sodium. While the old S-13 was a non-oscillating tube, with

Notes and Queries

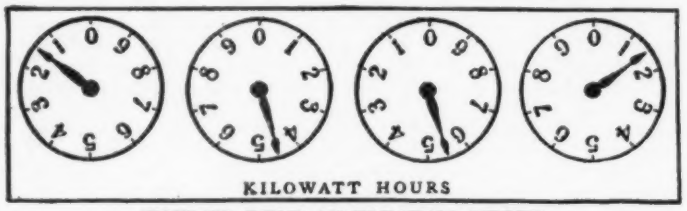
Conducted by Albert A. Hopkins

This department is intended for queries of general interest. Only a small percentage of the queries we receive can be printed here, the great majority being answered by mail. Except in special cases we cannot solve mathematical problems, give directions for building machinery or answer queries of a special nature which belong within the sphere of the professional engineer. All queries must give the name and address of the inquirer and must be accompanied by return postage. In writing about book orders or subscriptions please use separate sheets, give your name and address on each.

How to Read Gas and Electric Meters

W. J. H. says: *"I have both gas and electric meters and I cannot read either. Will you kindly tell a layman the code used by the inspectors who read the meters?"*

ANSWER: On this page you will find drawings of the die-stamped recording dials on gas and electric meters in general use with instructions for reading.

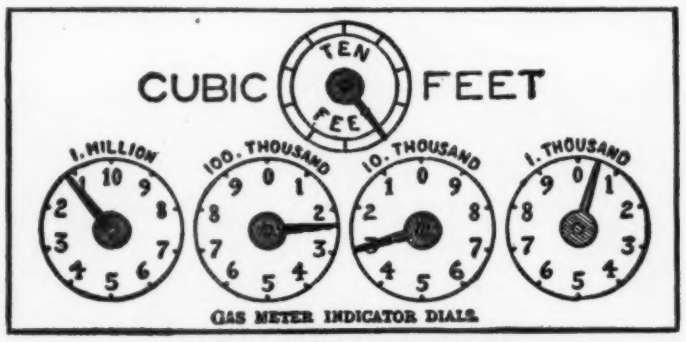


HOW TO READ AN ELECTRIC METER

Electricity is measured by the kilowatt hour (K.W.H.). There are usually four dials, each having its value marked above it. The numbers on the four dials which the respective pointers have passed are noted down from right to left. The reading so obtained is the amount of electricity that has passed through the meter since the last setting. The amount used since the last reading is the difference between the two readings. For example:

Meter above reads	**1,451 K.W.H.**
If previous reading were	**920 K.W.H.**
Amount consumed	**531 K.W.H.**

Some meters have a note beneath the dial saying "Multiply by 10." fn such cases the difference should be multiplied by this constant to obtain the K.W. hours.



GAS METER INDICATOR DIALS

HOW TO READ A GAS METER

The dial marked "1 Thousand" in the accompanying illustration is divided into hundreds; the dial marked "10 Thousand" is divided into thousands; that marked "100 Thousand" into ten-thousands, and that marked "1 Million" into hundred-thousands. When 1,000 cubic feet of gas have been consumed, the pointer on the dial marked "1 Thousand" will have made a complete rotation and the fact will be indicated by the pointer of the next dial at the left, which will point to the figure 1. When 10,000 cubic feet of gas have been consumed, the pointer on the "100 Thousand" dial will point to 1, and so on. The dial marked "Ten Feet," above the lower tier, is called the units dial. It is used for testing the meter to discover whether it is in working order or not

Gasoline Vapor Temperature

J. C. says: *"What is the degree of heat that is necessary to burn gasoline vapor?"*

ANSWER: We received such diverse information that we referred the matter to the Bureau of Standards and they reply as follows:

"It appears probable that Mr. C. has in mind the flash point of gasoline for what he terms the burning point and the spontaneous ignition temperature for what he terms flashing point.

"In engine work the term 'flash point' is frequently applied to the minimum mixture temperature at which ignition at one point will be propagated through the entire mixture. The flash point for gasoline is well below 0 degrees Centigrade. The spontaneous ignition temperature of a mixture of fuel and air is the temperature to which it must be raised in order to spontaneously ignite throughout its mass. For gasoline in common use the spontaneous ignition temperature is above 300 degrees Centigrade."—300 degrees Centigrade equals 572 degrees Fahrenheit.

So-called Camel's Hair Brushes Made from Squirrel Tails

A. C. H. says: *"I am a painter by profession, that is to say an art worker, and I use many brushes.*

"I am wondering if the hair of camels which appear so coarse when I have seen these animals at the 'Zoo' is really used for making 'Camel's Hair Brushes.'"

ANSWER: "Camel's Hair Brushes" are made from the tails of Russian and Siberian squirrels, at least this was the source of supply before the war.

The Pleasures of Studying Astronomy

R. F. A. says: *"I have never yet seen anything which would lead me to study astronomy other than for the information which I can obtain therefrom. Is it not really a cultural study?"*

ANSWER: It is, Tennyson, who, of all the brethren of his craft, did most to poetize the facts of astronomy, speaks of the stars as "cold fires, yet with power to burn and brand his nothingness into man." Nonentity has its advantages. A sovereign remedy for the trivial worries of human life is the contemplation of the starlit sky and the realization of the infinitesimal importance of the earth and all things earthly in comparison with a boundless universe.

The nightly spectacle of the stars is, however, commonly ignored. Many people look at it all their lives without really seeing it. The more conspicuous constellations ought to be as familiar to every human being with two eyes in his head as the town hall or his next-door neighbor's stable. They are far from being so. Most people will admit frankly that the only constellation they know by sight is the Big Dipper—which, as it happens, is not a constellation at all.

A knowledge of the heavens is more general in primitive and pioneer communities than in centers of civilization and culture. The pastoral tribes of Chaldea and Arabia, thirty centuries ago, were better acquainted with the stars than are modern New Yorkers and Londoners.

The relative "nothingness" of the earth and its inhabitants is chiefly a modern idea, though it was not entirely unfamiliar to the speculative philosophers of antiquity. Thanks to the brilliant labors of many astronomers—of whom Copernicus should be mentioned first of all—we now know that the world on which we live is a planet, or satellite, revolving humbly around an enormously greater body, which we call the sun; and we know that the sun, in its turn, is a rather unimportant member of a vast system of suns, or stars. The sun looks bigger than the other stars only because it is nearer to us.

How many stars are there? Survey the heavens on a cloudless and moonless night, and you will probably get impression that the number visible to the naked eye is almost infinite. This impression is, however, quite erroneous. The greatest number of stars which the unaided eye can distinguish at any one place on the earth and at any one time is hardly more than two thousand. With an opera-glass many thousands more can be seen, and this little instrument will be found an invaluable adjunct in a study of the heavens.

Air Pressure Below Sea Level

G. S. DEH., of Richmond, Va., says: *"In a discussion with another man who is of a scientific turn of mind, we came to a standstill in regard to the air pressure below sea level. We know that at sea level it is approximately 14.7 pounds per square inch, and we know that as we go up on a mountain top that the air pressure grows less. Now the question is, does air pressure grow less as one gets below sea level or does it get greater and if greater what would be the approximate pressure at the center of the earth, also is gravity strongest at sea level or does it increase as one nears the center of the earth?"*

ANSWER: The air pressure increases below sea level in a mine shaft or drill hole down into the earth. At about 1,800 feet above the sea the pressure is one pound less than at sea level. The pressure decreases another pound by about 2,000 feet more of elevation. In an open hole like a mine, a drop of perhaps 1,600 feet below sea level would raise the pressure a pound to 15.7 pounds. The layers of air whose weight is one pound per square inch would become thinner as we descend into the earth. What the air pressure would be at the center of the earth we do not know. Air pressure is simply the weight of air resting on a square inch. On the other hand gravity is greatest at the earth's surface, and diminishes as one goes either above or below the earth's surface. The pressure of the rock and earth strata increases as we descend into the earth, just as the air pressure does, because the weight resting on a surface increases as we descend into the earth.

First Aid in Case of Burns

J. C. C. says: *"I would like some common-sense advice as to the treatment of burns in the household."*

ANSWER: When the clothing catches fire, throw the person on the floor or ground, so that the flames will not rise toward the mouth and nostrils. Then without a moment's delay roll the person on the carpet, or, if possible, in a hearth-rug, so as to stifle the flames. If no rug can be had, use your coat. Keep the flame as much as possible from the face, so as to prevent the entrance of the hot air into the lungs. This can be done by beginning at the neck and shoulders with the wrapping. If the burn or scald involves considerable surface, symptoms of shock, varying from mere weakness to utter prostration, appear. This requires immediate attention, and a few drops of aromatic spirits of ammonia in water or a little brandy should be given, and repeated in a few moments until the return of strength is apparent.

A burn, superficial as far as depth is concerned but covering a large surface, especially in the case of small children and aged people, is usually considered more serious than a burn smaller in extent but deeper and more complete. If there is reason to suppose that hot air or steam has been inhaled, no time should be lost in obtaining the opinion of a physician as to the result of the injury to the throat or lungs.

The treatment of burns varies according to the character of the injury. If the burn or scald is slight, one of the best applications is a saturated solution of bicarbonate of soda (ordinary baking soda) in the form of a cold wet compress, keeping the linen used constantly wet with the solution. It is best not to open blisters caused by fire burns, electrical burns and sunburns.

In more severe cases a good application is carron oil, which is a mixture of linseed oil and limewater in equal parts. But a still better preparation consists of an ointment made by incorporating bicarbonate of soda with vaseline or petroleum jelly in the strength of three percent. Lard and baking soda mixed may also be used.

An Old Question—"Did the Titanic Go to the Bottom?"

F. H. R. says: *"In an argument among some old grads of my college I claim that anything which will sink in a tub of water will sink to the bottom of the ocean, vessels included. Others argue that a vessel will sink to a depth of about 4,000 feet and there remain floating between the surface and the bottom. Will you please inform us who is right?"*

ANSWER: Your inquiry has come to us very many times since the sinking of the *Titanic* and we have several times published the answer. The work of the submarine revived interest in the subject and now we have recently had a number of inquiries about the matter. Hence we will print the discussion of the topic again. Anything sinks in water when it weighs more than the same volume of water weighs. A cubic foot of fresh water weighs 62.4 pounds. Anything which weighs more than this per cubic foot will sink in fresh water. The density of sea water differs somewhat in different oceans and seas. It may be taken at about 1.03. At this figure a cubic foot of sea water would weigh about 64.27 pounds. Anything heavier than that per cubic foot will sink in sea water. Another most important factor is that water like all liquids is nearly incompressible. So incompressible is it that at the bottom of the deepest ocean, six miles below the surface the water is only about five percent heavier than at the surface, and a cubic foot of sea water at the bottom weighs only about sixty-seven pounds. Anything which weighs more than that per cubic foot will sink to the very bottom of the ocean in its deepest known place. Aluminum, the light metal, weighs 166.5 pounds per cubic foot; and stone weighs from 135 to 200 pounds per cubic foot. Of course, they go to the bottom anywhere when placed in water. There is a widespread impression that the tremendous pressure deep in the ocean will prevent sinking. Pressure has, however, nothing to do with the case.

The Famous "Squirrel Question"

K. J. *asks for a consideration of this question.*

ANSWER: This question, so often answered in our NOTES AND QUERIES, seems still to cling to our readers of argumentative proclivities. We, therefore, place the question in a form for reference for the convenience of all comers. In its treatment we take the relations in their mathematical and mechanical aspects and without the quibble on the words "around" or "about," so much used in the arguments presented by correspondents. In this matter we adopt the customary phraseology of our best authorities in celestial physics and dynamical engineering.

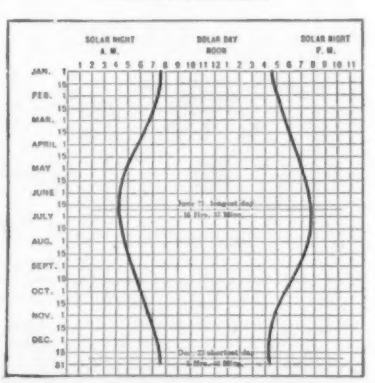
The condition of revolution of the inner body around or about which an outer body moves does not invalidate the fact of the revolution of the outer body around the inner body, nor of the two bodies around each other, as is exemplified in the declarations of astronomical authorities, that "the planets revolve around the sun" and "about the sun" and that the satellites move "around their planets," are characteristic of the movement of the hunter around a body within his own circle, whether the inner body is in motion or whether it is at rest.

A wheel revolves upon its axle. Its periphery revolves around every particle within its circumference, and any particular section of the periphery goes around the spokes, hub, and axle, or is successively on every side of their position.

The fact that a particular side of the hub is always turned toward a particular part of the periphery does not negative the general terms of the question.

The question as generally put, "Does the hunter go around the squirrel?" clearly admits of an affirmative answer.

The quibble of "on all sides of the squirrel" should properly be incorporated in the body of the question, which would make its solution as clearly a negative one.



A chart showing the hour of sunrise and sunset for New England and the northwestern states

Duration of Daylight

A. L. M. says: *"I have looked in vain through almanacs for a chart showing the duration of daylight. Can you supply such a chart?"*

ANSWER: The curves in the diagram on this page show the hour of sunrise and sunset for New England and the northwestern States. The space between them indicates the duration of daylight, and outside them the duration of darkness. For more southerly points the curves would be more nearly straight, the shortest day being longer and the longest one shorter. Practically every good almanac will give you the hour of sunrise and sunset as well as the length of day and of twilight during the year.

The Basis of Printer's Measure

F. T. *writes from Le Havre, France, to ask us: "What is the fundamental unit used by printers to measure type in America. One of us says it is a length called the pica; another that it is a square called the em or the en?*

ANSWER: Neither is right. The fundamental unit of type measure is a length called the "point," which equals .01383 inch. This column is printed in 8-point type, which means that the space occupied by one line of type, if the lines were as close together as possible, would be .11064 inch. The "pica" is a 12-point type. The "em" is the square occupied by the letter M of any size of type. The "en" is the narrower space occupied by the letter N. These are not fundamental units.

Never An Artificial Man

B. D. M. asks: *"What great scientist of ancient times was it who made some kind of an artificial man or ape or monkey or something that was really alive?"*

ANSWER: No one ever did this. The story is an oft recurring one and has been embodied in literature in the famous tale of Frankenstein as well as in the still earlier folk legend of the Golem. Doubtless it took its root in some automaton built by ancient priests or magicians. That the temples of antiquity did contain such mechanical contrivances is well known. The statue of the vocal Memnon, in Egypt, is reported to have produced a sound like "Lo" by expansion of imprisoned air when the sun rose. The image of Moloch in Carthage is reported to have moved its arms similarly when a fire was built on the altar. A still more marvelous moving and speaking statue of Marduk, jointly with Ea one of the greater gods of Babylonia, is mentioned by some of the medieval writers. It is probable that recollections of these contrivances, exaggerated with time, are responsible for the many recorded legends of "artificial" animals and men.

How Washington is Planned

T. J. W. *writes from Sydney, N. S. W., to ask us about what he calls the "wheel" plan for cities.*

ANSWER: This refers, no doubt, to the so-called circular or "wheel-spoke" city plan, in which the main avenues radiate from one or more centers. A modification of this plan was used in planning Washington, D. C. The city is divided into four quadrants with the Capitol at the center, the quadrants being designated as northwest, northeast, southeast and southwest. Hence the "N. W.," "S. E.," and so on used in Washington addresses. This plan for cities was suitable enough in the days of carriages and ox carts. It is less in favor since the advent of the automobile.

Treasure Trove

B. L. K. asks: *"What success has been attained in salvaging the Laurentic?"*

ANSWER: The salvaging of the *Laurentic* has been extremely satisfactory, as $10,000,000 in gold bars was found stored in the forward part of the ship instead of in the bullion room. $35,000,000 in gold and silver bars has been brought up, which constitutes the greatest salvaging feat on record. The *Laurentic* was sunk by a submarine off the coast of Ireland in 1917 while taking bullion to New York. The ship lies in fifteen fathoms of water, and the salvage operations have lasted for a period of five years and have been conducted entirely without loss of life.

ECLIPSE COUPON

The report of your observations of the eclipse of the sun on January 24th, as described on pages 13 to 16 of our January issue and page 86 of this issue, may be sent in on this coupon. Or, if you prefer, you can write a letter with your answers. In the latter case be sure to answer as many of the questions below as you can.

Read carefully the directions printed on pages 14 and 15 of our January issue. Do this now. If there is anything that you do not understand write to the Editor of the Scientific American for further explanation.

Mail your report—whether on this coupon or in a letter—to either one of the following addresses:

The Editor, Scientific American, 233 Broadway, New York City — or — The National Research Council, Washington, D. C.

Do not forget to put your own name and address on the report so that we can ask you for further information later should that be necessary.

Full information about the times and places of the eclipse will be found on pages 14 and 15 of our January issue and on page 86 of this issue.

Question 1. *If the sun is not quite eclipsed at your station there will always be a bright edge of the sun visible, or perhaps only a single point. One bright point may appear on one edge of the sun before the other has entirely disappeared. At your station was there any time at which* no *bright edge of the sun was visible? Answer YES or NO.....*

Question 2. *If the bright edge of the sun* entirely *disappeared, how many seconds elapsed before another bright part of the sun became visible? Answer.....seconds.*

Question 3. *Was the time set down in the last question merely guessed at or was it actually measured? If measured, how was the measurement made?.....*

.....

Question 4. *The fringe of light surrounding the sun and called the corona (see page 86) is fully visible only if the face of the sun is entirely covered. At your station was there any time at which you could see the corona* all *around the sun? Answer YES or NO.....*

Question 5. *Could you see any stars or planets at the time when the sun was most completely covered and how many did you see?.....*
(If convenient, draw a little map showing the positions in the sky of the eclipsed sun and of the stars and planets that you saw.)

Question 6. *If you are on a high building or a hill near the edge of the shadow path you may be able to see the shadow advancing across the country. If so, what buildings or other landmarks were inside and what were outside the edge of the shadow?.....*

Landmarks inside the shadow: .....

.....

Landmarks outside the shadow: .....

.....

Question 7. *It is necessary to locate your position* very accurately, *so that the engineers who compute the reports will know just where to place your observations on the map. Accordingly, give your position by means of the nearest street intersection (if in a city or town) or by means of some easily located building such as a railroad station, a town hall, or some landmark which can be placed easily on a map by a person familiar with the district*

.....

.....

If you have a map of your district, published in a newspaper or from any other source, mark a cross on the map at the position where you stood and send in the map with your report.

NAME .....

ADDRESS .....

We will be glad to send separate copies of this coupon to anyone who intends to observe the eclipse. Write the Editor, Scientific American, 233 Broadway, New York, N. Y., and ask for them.

The Psychic Investigation

A Letter from Dr. Walter Franklin Prince, Chairman of the Scientific American's Psychic Committee

IN the issue of the Scientific American for November, 1924, we published four statements from members of the Psychic Committee with regard to the famous mediumistic case of "Margery," now disclosed as Mrs. L. R. G. Crandon, of Boston, Massachusetts. These statements were supplied by Dr. Hereward Carrington, Dr. Daniel F. Comstock, Houdini and Dr. Walter Franklin Prince, all members of the Committee. Dr. William McDougal, the fifth member of the Committee, was absent at the time and did not contribute a statement.

In reply to these four statements, Dr. L. R. G. Crandon, husband of the medium, submitted a statement which we printed, without editorial change, in the issue of the Scientific American for January, 1925. Dr. Prince, as the Committee's Chairman, now contributes the following statement as a further discussion of some of the points raised by Dr. Crandon.

With the publication of the present statement the discussion of the past phases of this famous case will be concluded, so far as the columns of the Scientific American are concerned. We shall continue, however, to print accounts of any developments as well as any further reports made by the Committee on this or other cases.

The "Margery" case has attracted wide attention, in Europe as well as here. It is understood that several independent investigations are to be made by scientific and psychic authorities. Our readers may be assured, we believe, that the truth or falsity of the remarkable phenomena claimed in this case will be determined to full public satisfaction before the matter is allowed to drop. We shall continue to print the ascertainable news of any results obtained, either by our own Committee or by other competent and authoritative investigators.

THE EDITOR.

December 19, 1924.

Editor of the Scientific American

Dear Sir:

Forced to call attention to such of the errors in Dr. Crandon's statement in your January issue as I am in a position to recognize, I disclaim any feeling of hostility or resentment which would prevent my giving the most fair attention to any further experiments with "Margery" which I might be permitted to share. But so grave errors of fact, whether due to infirmities of memory, haste or emotion, should not be allowed to stand uncorrected in the record.

Dr. Crandon states that although theoretically "it could not be improved upon," yet the Committee of Judges had "certain very bad qualities" of which the "most important has been an entire lack of harmony and confidence between its members." "Your committee," he further declares, "has surrounded this mediumship with the acrid atmosphere of their distrust of each other."

So far as I am concerned, and so far as I have observed, this charge is far from accuracy. At no time have I been heard to utter a word of distrust of any member of the committee with whom I was sitting. At no time when I was present at a sitting have I heard or witnessed anything to indicate acrimony or distrust between members of the committee present. I did hear Houdini criticize Bird sharply, at or near the time of the sitting. But Bird was never a member of the committee. Houdini has, I believe, criticized Carrington, but that fact supports neither the statement that the whole committee was characterized by mutual distrust nor that the actual sittings were surrounded by the acrid atmosphere of that distrust.

It is asserted that "Dr. Prince, in three of his sittings, reports that phenomena occurred. In these sittings he exercized as much control as one man can, and his colleagues controlled every other channel of fraud or error." The fact is that at one of these sittings I was excluded from any part in the control, and that at no other night sitting when phenomena occurred and I was present did a colleague control every other channel of fraud or error, Dr. Crandon himself being on the other side of the psychic.

It is stated regarding me that "his report is couched in terms taking to himself the exclusive right to control every critical region." Certainly, from nothing in any written report of mine nor any oral declaration could any such inference justly be drawn. No such absurd notion ever entered my mind. There was no impropriety in my declining to sign a blanket report of what occurred on the evening when the screen was broken near Dr. McDougall. That was the night when I was placed on the other side of the circle from the medium and screen, and I was not in a position to give testimony, hence my plain common-sense remark, "of course I know nothing of that," meaning that, aside from the noise of the breaking I was not a witness of the facts.

It is not correct to say that "every condition of control they (the committee) have dictated" "Walter," the purported spirit control, was always the supreme arbiter of conditions. I do not complain of this, but only state the fact. For instance, at the beginning of my last evening sitting, I informed Dr. Crandon that I did not see how it would be possible for me to make progress toward a scientific conclusion so long as two conditions, (1) absolute darkness and (2) himself as one of the immediate controllers, were maintained. Exactly those conditions attended the sitting which followed.

The sentence, referring to me, "we do our best to meet his conditions, only to be met each time with new conditions," is so antipodal to the fact that it must represent a mere emotional reaction in consequence of the inability of the majority of the committee, including myself, to give an assured affirmative judgment in November. Only twice have I ever even suggested any change in conditions, and neither time was anything whatever done to meet my views. The first time was before the last night sitting I attended, when I told Dr. Crandon that I did not see how it would be possible to come to a conclusion unless either a red light were allowed or some other person than himself was a controller, and, as I have said, the sitting followed exactly as on the previous evening. The second time was when in the course of an exchange of letters I asked that I might have more daylight sittings, or at least might have assurance before going to Boston that a red light would be used at night sittings. But neither of these conditions was new. Other persons had been permitted to have sittings in red light, I never. I had already had one daylight sitting, ordered by the "control" himself, and it had been attended by *prima facie* success. The psychic seemed fresh and unwearied after it, offered every facility for frequent repetition of these conditions, and I have no reason to suppose that she is personally unwilling to redeem her promise. But her husband has constantly interposed objections, declaring among other things that I must first come to Boston before the control is asked for permission to repeat what the control himself directed. The only two conditions which I have ever requested, one allowed to others and the other previously allowed me, being denied, it is difficult to construe the matter otherwise than as a wish to exclude me from further participation. It is by the doctor himself that "the further development of this many-sided medium is being held up."

I do not understand what statement the committee is supposed to be under gentlemanly obligations to make, respecting an alleged "plant." It is unfortunate but true that only two persons in the world *know* what the facts in the case were. One of these has already made his statement public; the other is fully at liberty to do the same and quote the exact language in which the charge against him was made at the time.

It is an innuendo against four members of the committee to single out Mr. Carrington's report alone as an "honest" one and the conduct of Messrs. Munn, Free and Bird as "courtesy and absolute fairness." Speaking for myself, if there is any dishonesty in my reports or inconsistency between them and my "report of progress," or if at any time my conduct has been lacking in courtesy and absolute fairness, specifications should be given. I challenge their production. The only person connected with the investigation in respect to whom I have ever addressed language or employed conduct which might be deemed criticizing or hampering is Mr. Houdini, to whom I am supposed to be particularly friendly.

My influence has steadily been exerted to prevent and smooth over, to the best of my ability, everything which could unsettle the nervous condition of the psychic, and thus interfere with the supernormal powers claimed. I am confident that she will not assert otherwise. And I am ready to utilize any future opportunities which offer a reasonable hope of advance, in the most fair and candid spirit.

Truly yours,

Walter Franklin Prince.

SCIENCE NOTES

The Sun's Place in the Universe

STATISTICS of the stars, which are becoming increasingly valuable each year as the astronomer finds new and illuminating data continually coming to hand, do not give our sun such a flattering position in the universe as we might wish. A small, yellow, dwarf star is its rating in a universe of some hundreds of millions of stars. Its position is fifty light years above the central plane of the Milky Way and fifty thousand or more light years from its center. It is situated in the midst of a local starcloud, not over three thousand light years in diameter. This starcloud is more or less permeated with and enveloped by vast expanses of dark nebulous matter.

It was but a few centuries ago that man looked upon the sun as an attendant of the earth which was then held to be the center of creation. Then it came about, surprisingly, that the sun was after all the ruler of the planetary system and the earth was only a puny attendant of the sun.

Knowing even this, man clung to the belief that the sun was the center of the universe, for the distances and distribution of the stars were still unknown. It was the general idea that the stars were all equally distant, arranged in a sort of spherical shell with the sun at the center.

Another unpleasant shock was still to come to the geocentrically inclined members of the human race. The stars were proved not to be all equally distant, but were flowing to and fro in streams in or parallel to the Milky Way; while the sun was moving onward through space at the rate of a million miles a day.

The distances to the stars turned out to be tremendous, inconceivable. The nearest star was something like twenty-six trillion miles

(*Continued on page 142*)

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away. Its light took four and a third years to reach us, though it traveled 186,000 miles every second. Other stars were found—ten, a hundred, a thousand times more distant. Each star, however, had the comfortable average elbow room of several trillions of miles. Old, conservative ideas of the universe were thus completely upset.

As a last straw for the old geocentric theorists came the discovery in the present decade that we are something like fifty thousand light years from the center of our universe.

Dr. Harlow Shapley's estimate of three hundred and fifty thousand light years for the diameter of the Milky Way has not passed unchallenged. Some astronomers consider this estimate of the order of ten times too large. The general weight of the evidence at present seems, nevertheless, to be in favor of this greater estimate of the size of the Milky Way. It is to the Milky Way or galactic system of stars that our own sun belongs. Through it we and the sun are moving at the rate of a million miles every day.

At that rate it would still take us pretty close to eight hundred million years to reach that coveted position at the center of the universe; a time period longer than most of the geologic eons of the past.—Abstract from article by Isabel M. Lewis in *Science* (London), Oct. 31, 1924.

* * *

Ancient Ice Crystals and Present-day Quicksilver

THE practical value of the service of the geological profession to the commonwealth is, with every year, being more and more appreciated, especially among people who are developing the mineral resources of our country. Nevertheless, we still hear men who speak of geologists as theorists that render our profitable industries but little assistance. It is true that much of the work that geologists do has but a remote bearing on practical questions. The fact is that in geology, as in other sciences, one can never know when a purely scientific observation may turn out to have a practical application.

The examples usually offered to illustrate this fact have to do with the location of oil. A little variety is introduced into the geologist's field of practical usefulness by some recent work of J. A. Udden, of the University of Texas. At various times between 1890 and 1904 he had noted in various parts of the western hemisphere certain curious sandstone markings which struck him as undoubtedly "fossil ice crystals." In 1909 he was able to verify his impression that they were of this origin, by noting the formation of exactly similar marks in current mud that was undergoing the process of freezing.

It might well appear that nothing was further from practical application than the observation and study of the kind of crystals that are formed when water freezes into mud. The assignment of the freezing to a remote geological period hardly seems to add to the practical value of the investigation. Nevertheless, in following up a faulted quicksilver vein in western Texas, inferences based upon the recognition of these fossil ice crystals in a formation of a certain type enabled him to predict with certainty not only the right horizon for the quicksilver deposits, but also to predict the presence and location of an underlying water-bearing stratum which had to be avoided in order to prevent serious damage to the underground workings.—J. A. Udden, *Bureau of Economic Geology and Technology, U. of Tex.*, Austin, Tex.

* * *

Resuscitated Fish

EXPERIMENTS conducted at the Atlantic Biological Station, St. Andrews, N. B., by Dr. S. W. Britton, on the degree of heat or cold which fish can withstand, show that they may be chilled to the extent that their hearts stop beating and the whole body is stiff and numb. Then, if the temperature be raised, they will soon recover.

The experiments were performed on such fishes as the flounder, eel, cod, and skate. These fish were living normally in a tank of water at a temperature of about sixty-five degrees, Fahrenheit. From this tank they were transferred to cooling or warming tanks in which the temperature of the water was gradually lowered or raised.

In the cooling tank the water began to freeze at about twenty-nine degrees, Fahrenheit. Under these circumstances it was found that the fish could show activity for only a short time. Regardless of whether the cooling was slow or sudden, they would gradually stiffen. The heart was the last organ to cease motion. The fish were kept in the water in this condition for from one to several hours, but could afterward be resuscitated simply by raising the temperature.

The opposite extreme to which the fish were subjected was eighty degrees, Fahrenheit. With a gradual increase of temperature the fish showed restlessness and excitability. At seventy-five degrees respiration became difficult, but if the water was maintained at this point a gradual adjustment took place and the fish got along quite comfortably. When the temperature was further increased respiration ceased and the heart stopped beating. The fish could, however, be revived by lowering the temperature of the water or by transferring them to a cooler tank.

* * *

Infantile Paralysis—What Not to Do to Help It

"POLIOMYELITIS is an acute infectious and communicable or contagious disease," stated Dr. LeRoy W. Hubbard, Orthopedic Surgeon of the New York State Department of Health, in one of the State Health Department's regular health talks broadcast by the General Electric Company from Station WGY (Schenectady, N. Y.). He states further that altogether during the past four years over 2,000 known cases of this disease have occurred and he estimates that there have been as many more so mild as not to have been recognized and hence not reported. "It may or may not be followed by paralysis or weakening of some or even all of the muscles of the body," says Dr. Hubbard. "Many victims are not paralyzed at all, others have slight paralysis which disappears promptly, while in the most severe ones the paralysis or muscle weakness remains more or less permanent.

"The germs which cause the disease enter the body probably through the nose and mouth, get into the blood and finally lodge in the spinal cord, which becomes inflamed. If the inflammation is slight its effects pass off quickly, but if it is severe, certain nerve cells in the spinal cord cannot do their work properly, and the muscles controlled by these cells become weak or completely paralyzed. When the inflammation is severe enough these cells are destroyed, and in such cases permanent paralysis results.

"The symptoms at the outset may be similar to those of almost any fever-producing disease. When paralysis develops it usually appears two to five days after the onset of the fever. It may commence in one group of muscles and gradually extend, or it may be more or less complete from the start. After two or three weeks there is usually a tendency to spontaneous recovery of some of the affected muscles—those controlled by the less severely inflamed nerve cells.

"No specific treatment for infantile paralysis has been discovered as yet, although experiments along that line are being made. So far the only treatment in the early stage and for several weeks thereafter which offers good results is absolute rest, both physical and mental. Even the exceedingly mild cases should be put to bed and kept there absolutely quiet. The worst possible treatment is any sort of manipulation of the spine or of the limbs.

"Bear in mind that poliomyelitis is the result of an inflammation, and the only treatment for inflammation is rest; when your eyes are inflamed you avoid using them as much as possible; if you have an inflamed joint Nature insists that you keep it at rest by making it hurt every time you move it. For the same reason you don't move your neck to any great extent when you have a boil, which is just another kind of inflammation. Then apply your common sense, and do not let a child's spine or legs be adjusted, massaged or given any other sort of manipulative treatment during the inflammatory stage of infantile paralysis. If you want him to have every chance of complete recovery see that he has absolute rest and quiet.

"Poliomyelitis is spread not only from case to case, but probably by persons called carriers—that is, people who have enough resistance to the germs so that they themselves do not acquire the disease, but who nevertheless can carry active germs in their mouth and nose secretions and pass them along to others who are susceptible. Contrary to the general belief, many instances of more than one case in a family have been found, although sometimes paralysis has not occurred in the second case.

"The only way of preventing the spread of poliomyelitis so far known, is by strict isolation of the active case together with the exercise of extreme caution to see that the well child is not exposed. This means keeping him away from crowds and strangers whenever the disease is prevalent.

* * *

How Much of the Metal Kettle Dissolves in Cooking Foods

THE average housewife has little occasion to think whether some of the metal of the utensils in which she cooks various foods will dissolve in the cooking process. Some interesting experiments on the presence of small quantities of metals in foodstuffs have been carried on in the state laboratory for hygienic research in Helsingfors, Finland.

In the laboratory referred to, according to a description of the work in a German pamphlet, experiments were made with various metal cooking vessels, with the object of determining the quantities of the metal absorbed by foodstuffs in the process of cooking. For the sake of simplicity, ordinary solutions of a suitable nature were used instead of the actual foodstuffs. It was found that 250 grams of a forty percent solution of sugar containing one percent of citric acid absorbed, when boiled for two hours in a copper kettle, twenty-five milligrams of copper; while a currant juice containing forty percent of sugar and 1.29 percent of acid (calculated as citric acid) absorbed twenty grams of copper. For determinations on salty foods, a five percent solution of salt was used. By boiling for three hours the following quantities of metal were dissolved in one kilogram:

Vessel.	Fruit juice containing 40 percent sugar and 1.5 percent acid, Milligrams	5 percent salt solution, Milligrams
Iron pot	1,400	104.0 iron
Untinned copper kettle	65	70.0 copper
Tinned copper kettle	27	7.0 tin
Nickel kettle	76	4.0 nickel
Aluminum kettle	120	9.0 aluminum
Brass kettle	0.5	1.2 copper
Brass kettle	2.1	2.0 zinc
Enamelled kettle	6,000	.. salts

It will be seen that salty foods dissolve far less metal than those containing acid, any metal—with the exception of untinned copper—being suitable for the preparation of salty foods. For acid sugar juices, copper, tin, nickel, aluminum and iron vessels appear to be not without danger. Brass exhibits an unexpectedly small tendency to give up copper or zinc, and would therefore be an excellent metal from an hygienic point of view, in which to cook foods.

* * *

Animal Life in Deserts

IN a recent number of the Proceedings of the Royal Society for 1924, Mr. P. A. Buxton records the results of some investigations made in Palestine on the relations of temperature and moisture to animal life in deserts.

This observer finds that the soil surface in that region commonly reaches 140 degrees, Fahrenheit, at mid-day, and that certain insects are active upon it even at that temperature. Their body temperature is found to be lower than might be expected, probably owing to the loss of water during respiration. An interesting point is that the black form of a dimorphic grasshopper has a body-temperature nine or ten degrees higher than the buff form, when exposed to the sun.

If the loss of water hypothesis be correct the insect's need for water is greater than

is commonly believed. Deserts have a great diurnal range of temperature and of relative humidity. The night air is often almost or quite saturated with moisture, while by day the humidity may drop to twenty percent.

It appears that the dried fragments of the annual desert vegetation are hygroscopic; that is, they take up a considerable proportion of water from the moist night air and retain it for several hours after the sun has risen. It is thought that this property of the dried pieces of grass and herbage is one of the foundations which support all animal life in deserts during summer. These fragments, with the moisture absorbed over night, are eaten by certain insects. Thus they become a source not only of food but also of water, for the birds, lizards, predaceous insects, and other carnivorous animals.

* * *

Lead Used in Telephone Industry

QUITE astonishing, when presented in concrete form, is the role which lead plays in industry in general and in the life of the people as a whole. Some very interesting data has recently been collected as to the amount of lead used by telephone companies in the United States. The compilation is credited to the National Lead Company. Some of the salient facts presented are as follows:

There are about seventy-six million fuses in the telephone systems of the country and all contain lead. Every telephone line has, in addition to a fuse, a device called a protector. Certain small particles of lead in these protectors, which are found both in the exchange and at the subscriber's end of the telephone line, melt when lightning strikes the line and thus break the path over which the current is traveling.

Every time you telephone, you summon the help of lead. In the telephone instrument and box there is an average of fifty-one soldered connections. Lead is employed in all of them. The exchanges in the United States and the telephone lines running out of them have billions of soldered connections, with a total of about 322,000,000 pounds of lead in them. Every year, changes in connections require the use of about 70,000,000 more pounds of lead.

Furthermore, one company uses in a year more than 53,000,000 pounds to cover 35,300,000 feet of cable. Today there are in America about 82,000 miles of telephone, telegraph, radio and electric light cable covered with lead—327,300,000 pounds of it.

* * *

How to Enjoy Reading About Chemistry

CAN the subject of industrial chemistry, the chemistry of such things as steel and fertilizer and perfumes, be clothed in such plain language that the average man who once studied a little chemistry will actually enjoy reading about it? It can. Dr. H. E. Howe has done so in *Chemistry in Industry*, a book edited by him and published by the Chemical Foundation, New York.

When the ordinary man buys books about chemistry he wants to be assured that the treatment is not too technical. But many writers in an attempt to avoid abstruseness write down to the level of the moron. This is equally undesirable. *Chemistry in Industry* avoids both extremes.

Its immediate purpose was to prepare a background for those who wish to compete for the prize essay contest of the American Chemical Society, and it reads along so smoothly that an associate editor of the Scientific American has really enjoyed reading it. The twenty-one chapters were written by twenty-one different authors, most of whom are in a position to write authoritatively.

For instance, Robert E. Rose, director of the technical laboratory of the E. I. duPont de Nemours and Co., Inc., writes of the foundations of the chemical industry. Buckner Speed, technical expert of the Western Electric Co., writes of chemistry in the electrical industry. M. A. Krimmel of the Hammermill Paper Company discusses chemistry in the paper industry. The other contributors are of the same high standing.

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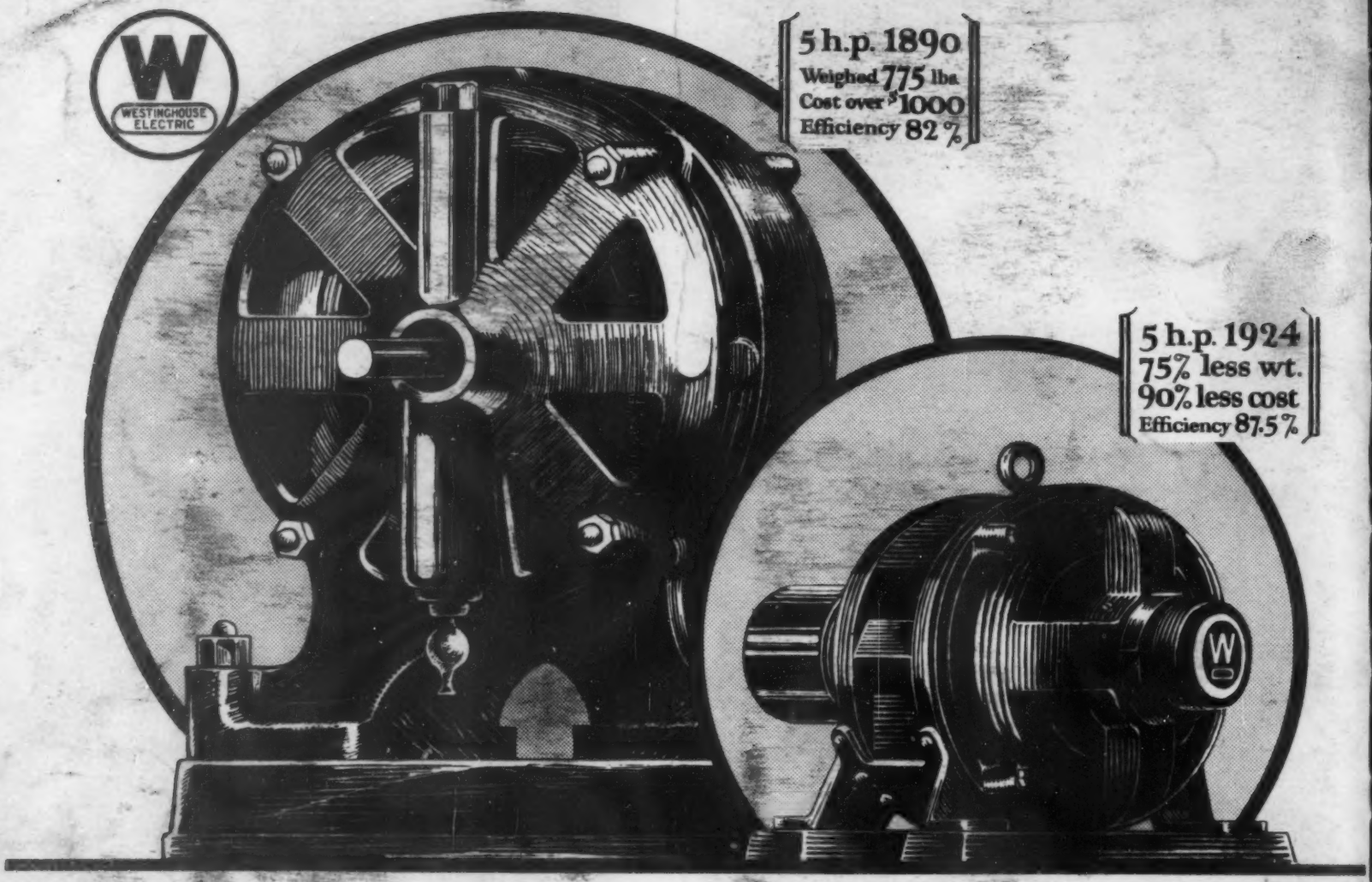

The Cash Value of Research

Seldom does one find more dramatic testimony to the work of the engineer and the laboratory than in the pictures on this page.

The motor of 1890 was a great improvement over the original Westinghouse-Telsa, the first practical alternating current motor to be built.

But in the years that have followed, the same Westinghouse research, which gave this new source of power to industry, has increased motor earning capacity and enormously decreased motor size and cost.

Had there been no improvement in design or in manufacturing methods, it would now cost more than $1,000 to build the CS motor shown at the left, whereas with the improvements made by engineering research, this same motor now costs only $100, this in spite of advancing labor rates and rising costs for raw materials.

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